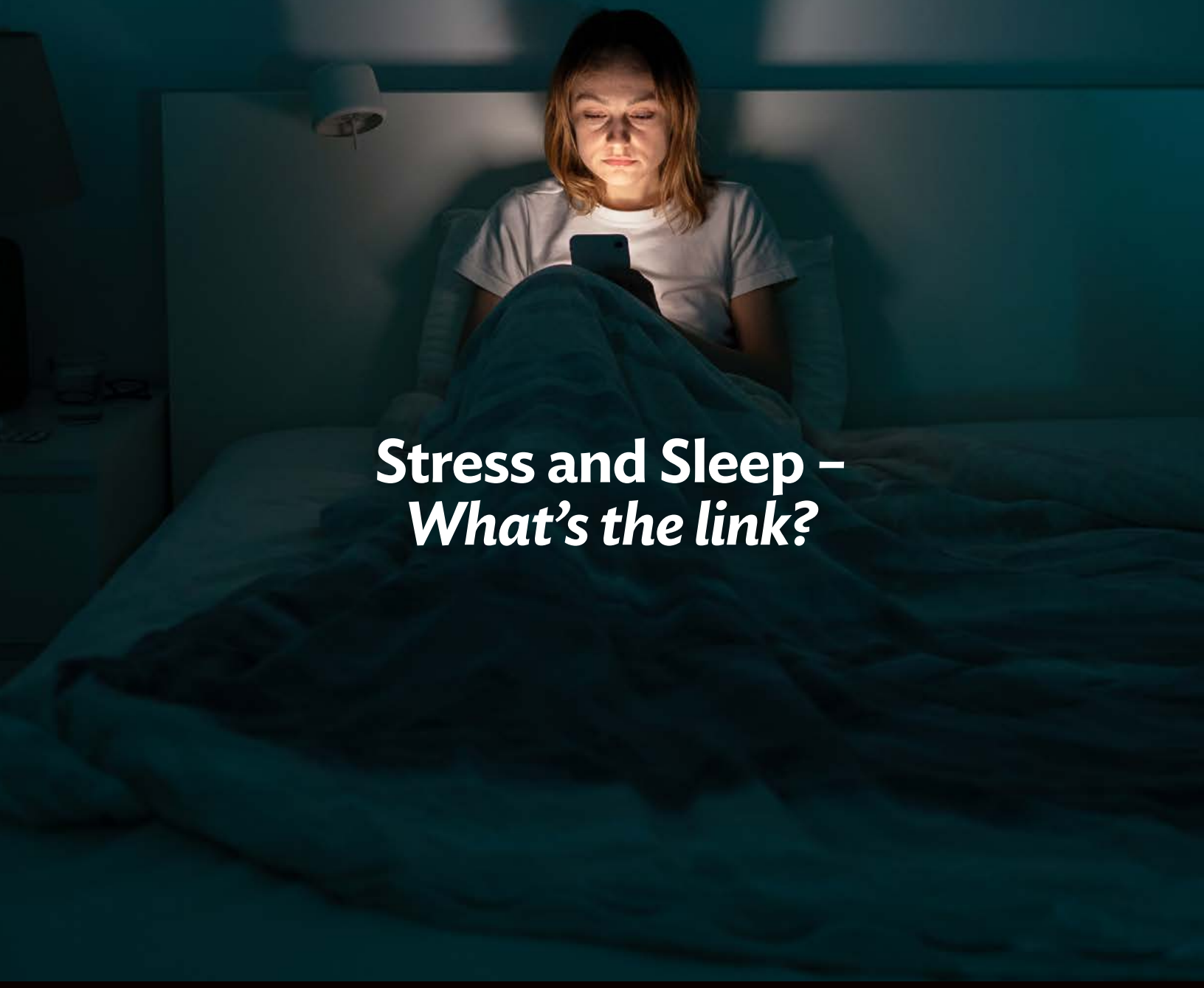
The American Institute of Stress

CONTENTMENT

A Magazine on the Relationship Between Stress, Health and Longevity

Volume 11 Number 4 ***Winter 2022***



Stress and Sleep – *What's the link?*

The mission of the nonprofit American Institute of Stress is to improve the health of our community and the world by setting the standard of excellence of stress management in education, research, clinical care and the workplace. Diverse and inclusive, AIS educates healthcare practitioners, scientists, and the public. AIS is the only Institute in America solely dedicated to providing information, training and techniques to prevent and reverse human disorders related to stress, and to improve the quality of life and increase longevity through building resilience to stress. Credentialed AIS members provide leadership to the world on stress related topics.

Your source for science-based stress management information

CONTENTMENT

We value opinions of our readers.

Contentment is a quarterly magazine published in Spring, Summer, Fall and Winter with news and advertising designed with the general public in mind. It appeals to all those interested in the myriad and complex interrelationships between stress and health because technical jargon is avoided and it is easy to understand. *Contentment magazine is indexed by EBSCO and archived online at stress.org.* Information in this publication is carefully compiled to ensure accuracy.

Please feel free to contact us with any comments, suggestions or inquiries. Email: editor@stress.org

The American Institute of Stress

Stress Management Experts Wanted!

Obtaining credentials from The American Institute of Stress is a designation that sets members apart as stress experts and reflects their commitment to the advancement of innovative and scientifically based stress management protocols. The AIS Seal and credentials inform the public that the certificate holder commands advanced knowledge of the latest stress research and stress management techniques. For physicians and other healthcare practitioners, it designates your practice as an advanced treatment center for stress-related illnesses.


The American Institute of Stress

This is to certify that

Heather Smith, MD

Having satisfied the requirements for education, training and experience,

is duly qualified and has been elected to the status of

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The American Institute of Stress is a 501c3 non-profit organization, headquartered in Weatherford, Texas. We serve the global community through both online and in-person programs and classes. The Institute is dedicated to advancing understanding of the role of stress in health and illness, the nature and importance of mind/body relationships and how to use our vast innate potential for self-healing. Our paramount goal at the AIS is to provide a clearinghouse of stress related information to the general public, physicians, health professionals and lay individuals interested in exploring the multitudinous and varied effects of stress on our health and quality of life.

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BODY ELECTRIC

Electroceuticals and the Future of Medicine

A documentary film to revolutionize the way we think about health and the human body.

The American Institute of Stress is an executive producer of Body Electric: Electroceuticals and the Future of Medicine, a documentary film aimed to revolutionize the way we think about health and the human body. This 68 minute movie, by British producer/director/writer Justin Smith, is available online and on DVD for purchase through AIS.

Click here to buy the DVD for $19.95 or the digital streaming for $9.95

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AIS

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For so many Americans, "mysterious" problems ranging from mild to severe are caused by that scourge of modern life – stress. That realization is the first step toward healing, but it often raises many more questions that must be addressed. How is stress affecting my life? My relationships? My work? My happiness? What can I do to reduce or better cope with it? Our Stress Mastery Questionnaire – an easy and confidential online self-assessment that comes with our Stress Mastery Guide and Workbook – can help you find answers. And life-changing solutions.

SMQ™ STRESS MASTERY QUESTIONNAIRE

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Volume 11 | Number 4 **Winter 2022**

Editor's Message

Cynthia Ackrill, MD, PCC, FAIS
Editor

Sleep... critical to all human functions, frequently cheated, and way too often, elusive! And for any of us who have been awake at 3 am worrying about the effects of not enough sleep... it's time to lose both the distress and the shame and find some answers.

Why is something so basic such a challenge? Maybe as a result of a perfect storm: a short-sited modern society that values productivity and "busy-ness" over meeting the essential human needs for resilient brilliance and thriving; "modern advances" that have disconnected us from nature and its natural rhythms, even the biologically relevant cycles of light and dark exposure; a multitude of distractions, stimulants, and worries to ramp up the mind 24/7; declining daytime health choices — such as nutrition, movement, and social connection; environmental disruption of our hormones and chemistry; and a poor understanding of the science of sleep and why it is critical to every aspect of well-being from our immune systems to our emotional regulation to our physical and mental health and capacities.

Some of the factors are not in our control, but many are. I am so pleased to share these articles, packed full of science and practical ideas to inspire us all to reclaim sleep and all its power.

We start off with the follow up article promised by **Lewis Coleman, MD, FAIS** in the last issue of Contentment. He further explains the Mammalian Stress Mechanism teasing apart the three activation pathways and how they interact. In his brilliance he connects the dots to show how the human body responds to external and internal stressors through multiple, interacting chemical reactions affecting physical and mental outcomes. It's heavy science that may take more than one read to absorb, but it sets the stage to explain all the other aspects of stress, well-being, and longevity that we discuss.

A good laugh and a long sleep are the best cures in the doctor's book.

— Irish Proverb

Dr. Coleman then goes on to relate this mechanism to the theme of this issue — sleep, in his case, induced sleep or anesthesia. As an anesthesiologist he discusses the differences between anesthesia and analgesia and the disturbing missteps medicine has taken that may undermine our surgical outcomes. This should be shared with anyone in medicine, particularly your doctors! And on a more positive note, understanding this science will lead to

vastly different ways to approach the underlaying causes of disease in the future. He will expand these ideas in future issues. We are so fortunate to have his contributions!

The next article by **Jeff Jernigan, PhD, FAIS** gives a great overview of why we really can't live without sleep and how we might get more. So many factors go into the process of sleep, some of which we know and might be ignoring, such as good sleep hygiene, and some we might not have considered, such as how our brains may be challenged by moral distress and injury.

Evian Gordon MD, PhD, FAIS and Jennifer Franklin, Founder of Totally Immune, also review the symbiotic relationship of stress and sleep. They detail the importance of circadian rhythms and offer concrete advice on choices and habits that will enhance the function of those rhythms and thus result in better sleep and less stress. With their extensive background in connecting behavior habits to health outcomes they suggest evidence-based ways to form healthier habits.

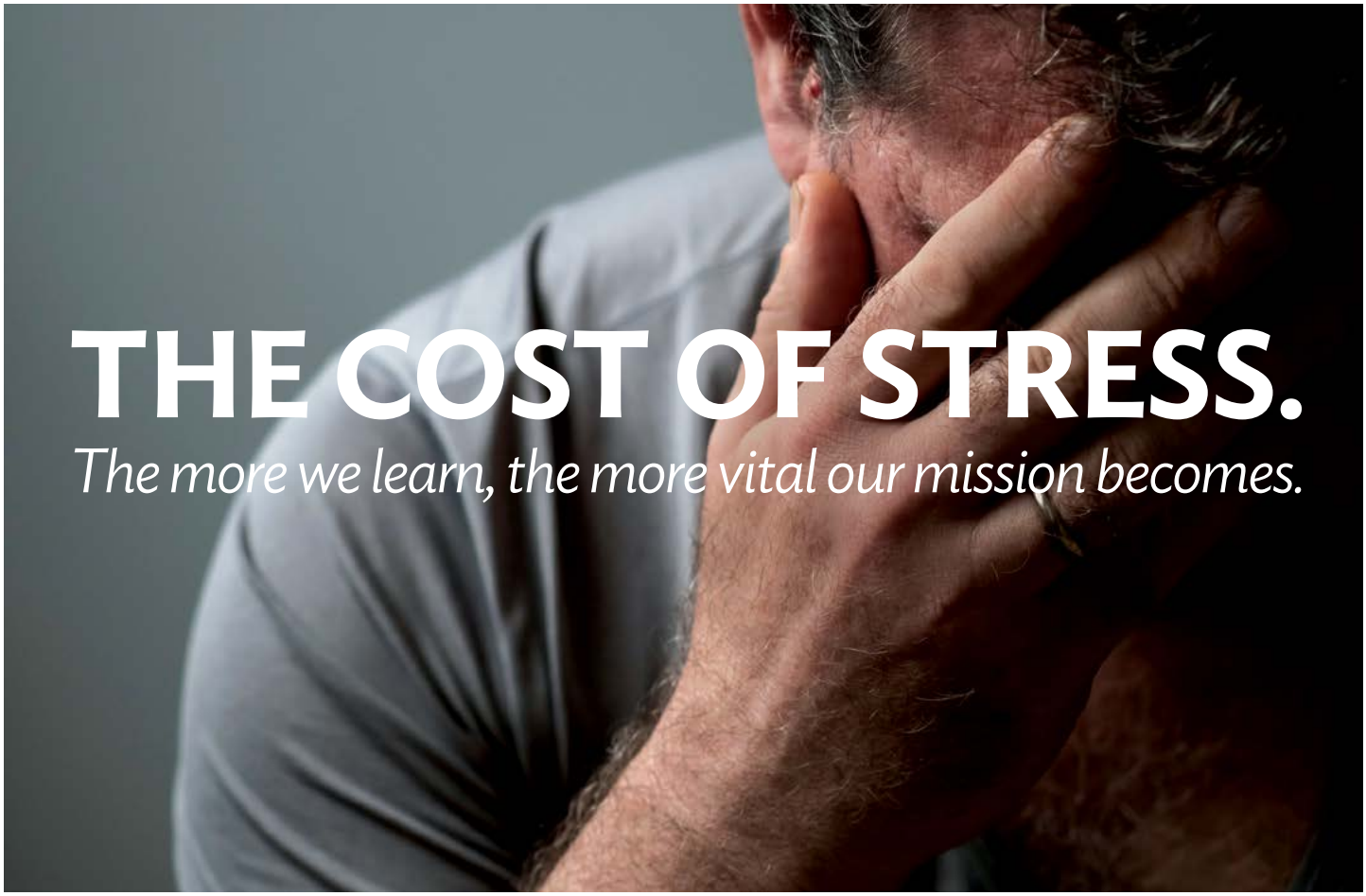
With all the bad rap gaming and technology get for sleep disturbances, **Rita Hitching BSc, MSc, PhD Candidate, Christopher Gordon BN, PhD, and Lisa Lampe MBBS, PhD, FRANZCP** collaborated on an interesting approach that just might leverage Virtual Reality (VR) for improving sleep. They review the alarming statistics of sleep difficulties (i.e., if you are sleep-challenged — you are not alone!), how stress is related to disrupted sleep, and what treatment approaches are out there. While CBT (cognitive behavioural therapy) has already shown to be helpful, they discuss how VR might enhance those mechanisms.

And lastly, **Josh Briley, PhD, BCMAS, FAIS Clinical Education Director at Electromedical Products International, Inc.** Alpha-Stim offers a totally different approach to sleep issues and at present is the only device in this category, thus the use of the name brand. In a society that is very medication focused, we may be discounting other powerful modalities for health, even those with significant scientific evidence. Because sleep is the result of complex interrelated factors, there is no one-size-fits-all solution. It's time to be curious about other approaches. Dr. Briley recounts both stories of discouraged, sleep-deprived individuals who found success with this electromedical approach and clinical evidence of its success.

This issue will be my last as editor as I move on to other projects — including more teaching, travel, family, and fun. It has been such a privilege to be amongst these minds and be able to share their insights with all of you.

Here's wishing you success in making your sleep more restorative and your mind and body more resilient!

Cindi



THE COST OF STRESS.

The more we learn, the more vital our mission becomes.

The American Institute of Stress is the only organization in the world solely created and dedicated to study the science of stress and the advancement of innovative and scientifically based stress management techniques. AIS provides the latest evidence-based knowledge, research and management techniques for stress and stress-related disorders.

Groundbreaking insights and approaches. World-changing mission.

Hans Selye, MD, PhD (1907-1982), is known as the father of stress research. In the 1920s, Selye coined the term "stress" in the context of explaining his pioneering research into the signs and symptoms of disease curiously common in the majority of people who were ill, regardless of the diagnoses. Selye's concept of stress was revolutionary then, and it has only grown in significance in the century since he began his work. Founded in 1978 at Dr. Selye's request, the American Institute of Stress (AIS) continues his legacy of advancing the understanding of stress and its enormous impacts on health and well-being worldwide, both on an individual and societal level.

A forthcoming AIS initiative – called **Engage. Empower. Educate.** – will leverage the latest research, tools and best practices for managing stress to make a difference in a world increasingly impacted by the effects of stress out of control. We hope you will consider supporting this critical outreach campaign.

Click to view The American Institute of Stress Case Statement

A campaign to Engage. Empower. Educate.

The AIS campaign will support three key initiatives:

Engage *communities through public outreach*

Improve the health and well-being of our communities and the world by serving as a nonprofit clearinghouse for information on all stress-related subjects.

The American Institute of Stress produces and disseminates a significant amount of evidence-based information, but there is a need to share this material with a wider audience in the U.S. and around the world.

Support for this initiative will provide funding to expand the organization's public outreach for its website and social media, documentary films, magazines, podcasts, blogs and courses.

Empower *professionals through best practices*

Establish credentials, best practices, and standards of excellence for stress management and fostering intellectual discovery among scientists, healthcare professionals, medical practitioners and others in related fields.

AIS provides DAIS (Diplomate, AIS) and FAIS (Fellow, AIS) credentials for qualified healthcare professionals.

The AIS seal means a practitioner has training and experience in stress management and access to the latest stress research and techniques. It designates their practices as advanced treatment centers for stress-related illnesses.

Support for this initiative will provide funding to continually update best practices in the field.

Educate *all through the development and dissemination of evidence-based information*

Develop and provide information, training and techniques for use in education, research, clinical care and the workplace. Some of the research-based information AIS develops and disseminates includes:

- Productions – Mismatched: Your Brain Under Stress, a six-part documentary featuring some of the world's leading experts on stress. Released in March 2021.
- Publications – *Contentment* magazine and *Combat Stress* magazine for service members, veterans and first responders.
- Podcasts, webinars and website resources – The free podcast series Finding Contentment

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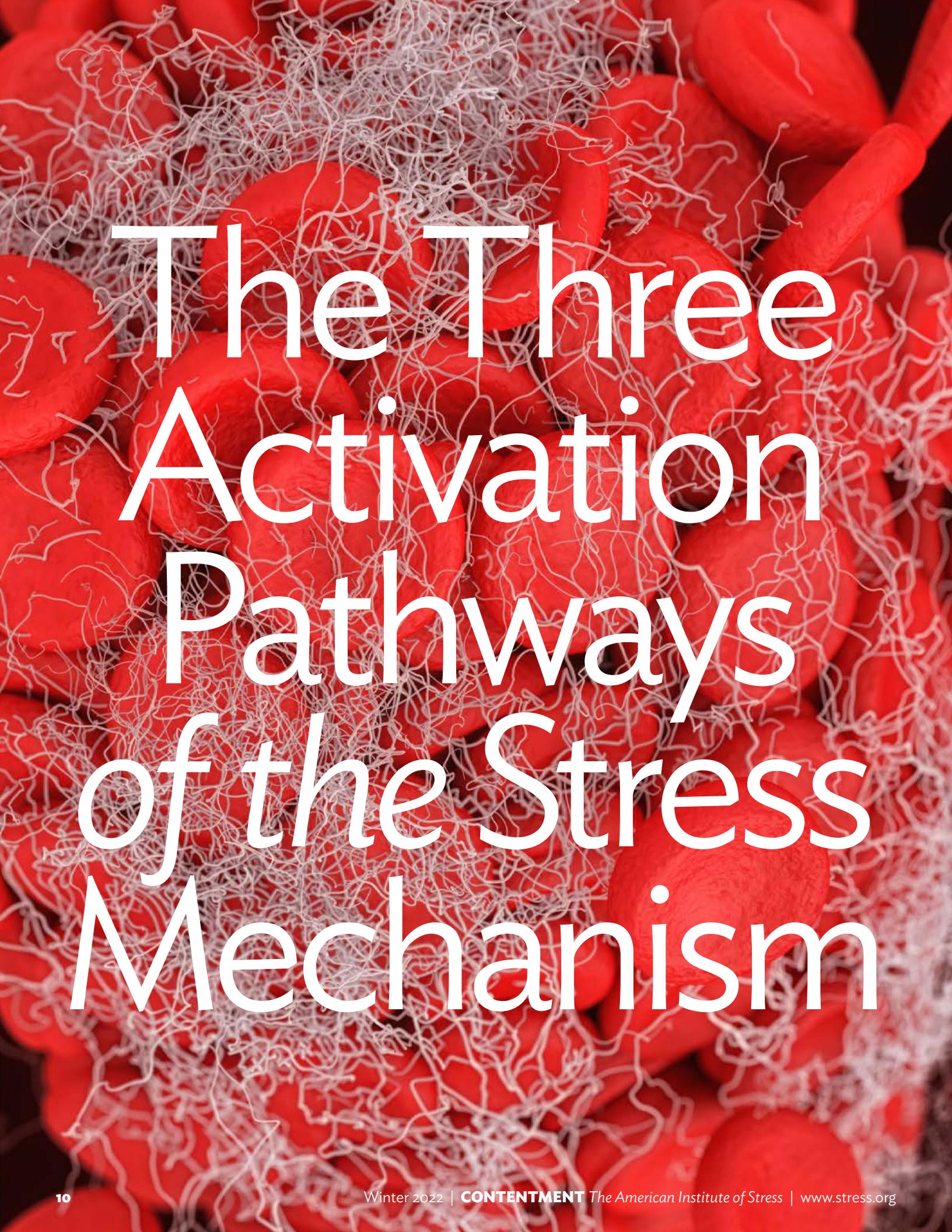


The Three Activation Pathways *of the* Stress Mechanism

By Lewis Coleman, MD, FAIS

In my previous essays I have offered an abbreviated description of the mammalian stress mechanism. This essay describes the three activation pathways of the stress mechanism in greater detail, in preparation for an explanation of revolutionary advancements in disease treatments.

Normally the mammalian stress mechanism functions efficiently and unobtrusively to repair tissues and regulate organs, but excessive and unrelenting combinations of environmental stresses induce stress mechanism hyperactivity via its three synergistic pathways. This causes harmful stress mechanism hyperactivity that manifests as disease. Thus, stress mechanism hyperactivity is the universal cause of disease, and this explains the similar symptoms and close relationships of seemingly unrelated illnesses. All forms

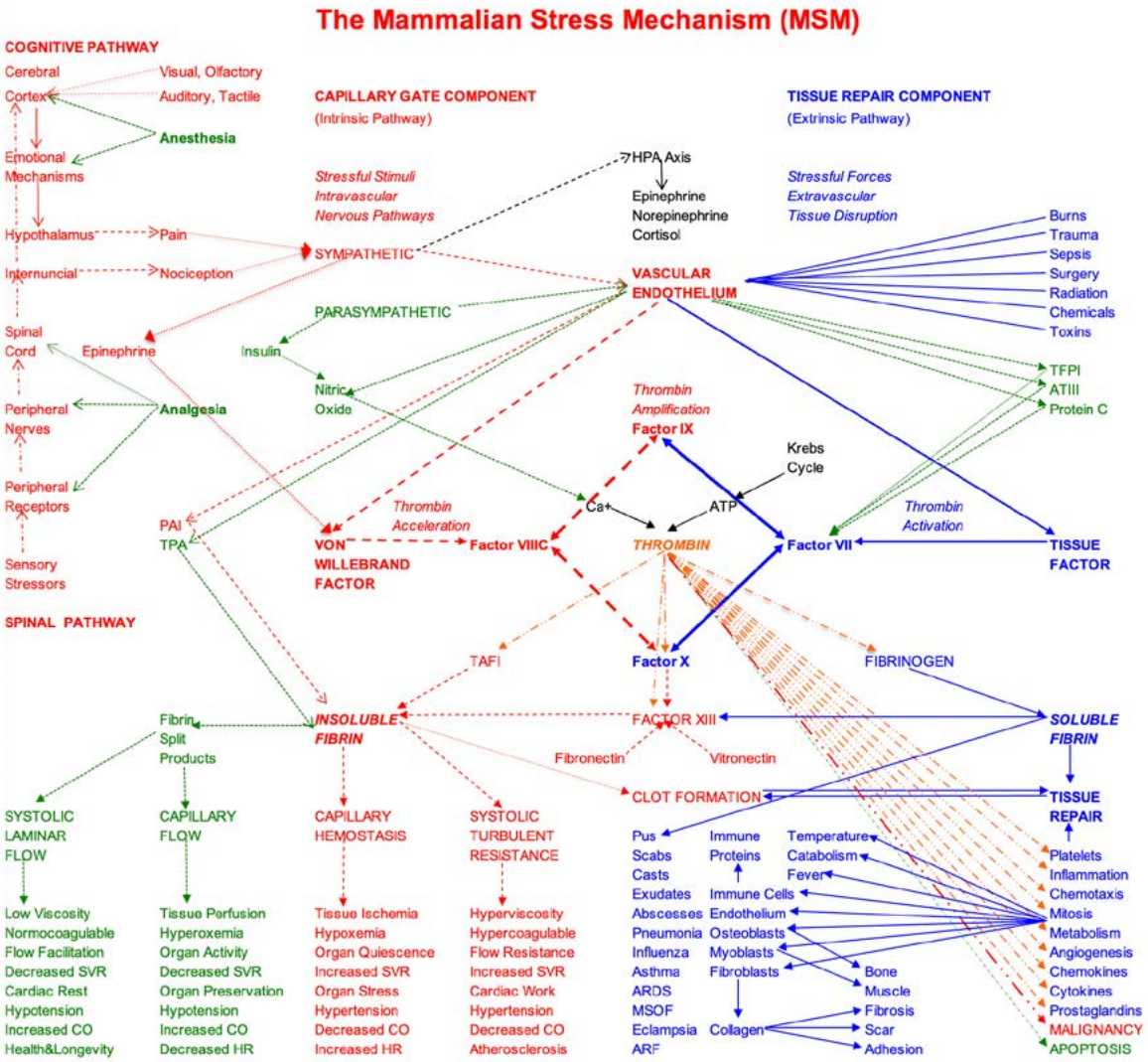


Figure 1. A diagram of the mammalian stress mechanism that illustrates its activation pathways. The cognitive pathway and the nociception pathway are portrayed on the left as elements of the Capillary Gate Component that activates factor VIII. The Tissue Repair Component and the Tissue Disruption Pathway are essentially the same and are portrayed in blue on the right. Tissue disruption exposes factor VII to tissue factor, which activates factor VII. The activity of each component exaggerates that of the other to generate "positive feedback" and focuses the powerful effects of the stress mechanism to repair tissues and regulate physiology.

of disease threaten longevity by causing harmful stress mechanism hyperactivity that depletes and squanders stress mechanism substrates and produces excessive quantities and defective versions of its products that damage tissues and disrupt organs. The greater the severity of disease, and the longer it persists, the greater its threat to health and longevity.

To appreciate all this, one must understand how environmental stress factors activate the stress mechanism via its the three synergistic activation pathways. Each pathway responds to different types of environmental stress. The nociception pathway and the cognitive pathway are closely related nervous sensory pathways that activate blood enzyme factor VIII. The tissue disruption pathway is activated by tissue damage, which activates blood enzyme factor VII. The synergistic, independently fluctuating activities of the three pathways are altered by multiple factors, so that they produce confusing combinations of fluctuating disease manifestations that obscure the relative simplicity of the causative stress mechanism.

The Nociception Pathway consists of nociceptors (tissue disruption sensors in skin and internal organs), peripheral sensory nerves, and specialized spinal cord nociception pathways.

The Nociception Pathway

The Nociception Pathway consists of nociceptors (tissue disruption sensors in skin and internal organs), peripheral sensory nerves, and specialized spinal cord nociception pathways. Nociceptors are subspecialized into mechanoreceptors that detect tissue distortion and damage; proprioceptors that detect position and movement; and chemoreceptors that detect hypercarbia, hypoxia, and acid levels. They generate nervous activity called "nociception" that travels via peripheral sensory nerves to specialized spinal cord nociception pathways. The spinal cord pathways simultaneously conduct nociception to the brain AND to sympathetic ganglia that lie outside the spinal cord in the in the chest and abdomen.

Nociceptors and autonomic innervation are not uniformly distributed. Nociceptors are present in skin and internal organs but are absent in the brain. Similarly, the lung, brain, and bowel are replete with autonomic ganglia and a fine mesh of autonomic (sympathetic and parasympathetic) nerve endings that are lacking in muscle, skin, and connective tissues. Thus, nociception and autonomic activity primarily affect internal organs.

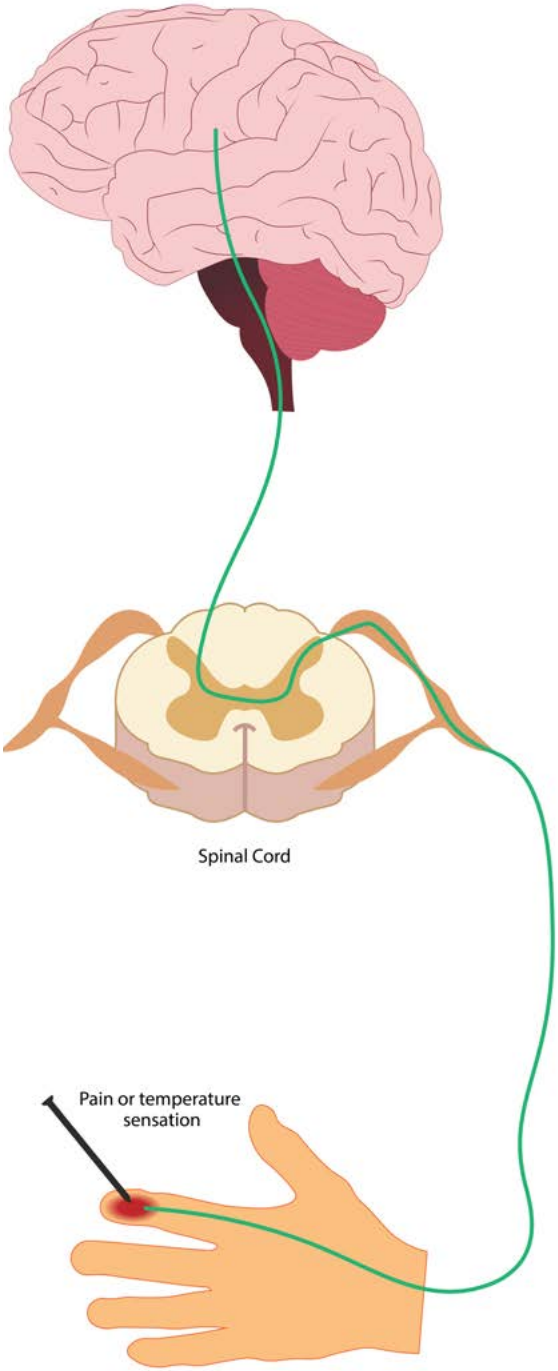
The sympathetic ganglia generate sympathetic nervous activity that increases microvascular flow resistance in organs, which decreases organ perfusion and inhibits organ function. Inflammation exaggerates nociceptor sensitivity, which explains why damaged tissues are painful. In addition, the spinal cord nociception pathways exhibit "windup syndrome" so that persistent stimulation amplifies their activity.

The brain interprets nociception as pain, which exaggerates sympathetic tone and activity. Anesthesia prevents brain function that interprets nociception as pain, but anesthesia has negligible effect on the spinal cord or sympathetic ganglia. Thus, general anesthesia must be supplemented with analgesia (such as narcotics or nerve blocks) to prevent harmful surgical sympathetic hyperactivity transmitted via spinal pathways during surgery.

Corticofugal Inhibition

The brain inhibits spinal cord nociception pathways via "corticofugal" (descending) nervous activity from the brain to the spinal cord.[1] This enables the brain to regulate pain perception in accord with environmental

circumstances. The classical example is that of a soldier who is wounded during battle but continues to function effectively while remaining unaware of his injury. However, when the excitement of the battle subsides, he suddenly becomes aware of incapacitating pain caused by his injury. Anesthesia abolishes this corticofugal inhibition, which is another reason that analgesia is necessary to optimize surgical outcome during general anesthesia.



Autonomic Hyperreflexia

Another example that illustrates corticofugal inhibition is quadriplegia, which is caused by spinal cord injuries high in the neck that disrupt communications between the brain and the spinal cord, while the spinal cord continues to function normally below the level of the injury. The brain no longer receives nociception signals from the lower parts of the body, so the victim remains unaware of painful stimulation below his neck and shoulders. The spinal cord is freed from corticofugal inhibition, so that uninhibited spinal cord nociception pathways become hyperactive. This produces a dangerous condition called "autonomic hyperreflexia" wherein trivial stimulation of tissues in the lower body causes exaggerated sympathetic nervous activity that manifests as tachycardia, hypertension, and decreased organ perfusion.

Anesthesia and Nociception

Consciousness interprets nociception as pain. General anesthesia inhibits consciousness and extinguishes the perception of nociception as pain in a progressive fashion. This conveys the powerful but false impression that anesthesia has analgesic properties. On the contrary, anesthesia abolishes the descending inhibition of spinal cord nociception pathways, even as it extinguishes the ability to perceive nociception as pain. This has the effect of indirectly exaggerating harmful surgical sympathetic nervous hyperactivity that undermines organ perfusion and oxygenation. As a result, general anesthesia must be supplemented with analgesia (such as narcotics) to optimize surgical outcome.[2]

Analgesia and Nociception

Analgesia inhibits nociception. There are three classes of analgesic agents:

1. Narcotics such as morphine inhibit

spinal cord nociception pathways. They are virtually free of toxicity, but they inhibit respiratory nociceptors. However, hypercarbia counteracts narcotic respiratory depression and speeds narcotic metabolism and clearance.[3-6]

2. Local analgesics such as lidocaine inhibit peripheral sensory nerves, spinal cord pathways, and nociceptors alike, depending on how and where they are administered. However, they are toxic and must be managed carefully.
3. NSAIDs (non-steroidal anti-inflammatory drugs) such as aspirin and Tylenol directly inhibit peripheral nociceptors. These are even more toxic than local analgesics.

Parasympathetic Nervous Activity

Sympathetic nervous activity is generally opposed and counterbalanced by "parasympathetic" nervous activity that originates in the brainstem and is conducted to internal organs by the vagus nerve. Parasympathetic nervous activity releases nitric oxide (NO) from the vascular endothelium, which opens the capillary gate, reduces microvascular flow resistance, increases capillary flow, and promotes organ function. In the research literature this is called "Nitrergic Neurogenic Vasodilation."

The Cognitive Pathway is of particular interest to AIS members because it explains how emotional adversity harms health, which has previously remained mysterious.

The Cognitive Pathway

The Cognitive Pathway is of particular interest to AIS members because it explains how emotional adversity harms health, which has previously remained mysterious. It consists of the cerebral cortex, which generates consciousness; a memory mechanism that records and retains an audiovisual record of all waking moments; a dreaming mechanism that evaluates the memory records during sleep to identify dangerous environmental circumstances; and an emotional mechanism that generates fear and anxiety when it detects dangerous circumstances identified during the dreaming process. These seemingly unrelated mechanisms function together as a mechanism of "fight or flight" that pre-emptively detects dangerous environmental circumstances and activates stress mechanism hyperactivity to facilitate survival in emergency situations.

Consciousness

Consciousness is generated by the cerebral cortex. It interprets nociception as pain, olfactory sensation as smell, optic sensation as sight, and auditory sensation as sound. It works with the memory mechanism to integrate all forms of sensory information into a unified perception of environmental surroundings.

The Memory Mechanism

The ability to retain vivid audiovisual memories, complete with associated emotions, of all waking moments was inadvertently discovered by Wilder Penfield, a neurosurgeon who stimulated various parts of the brain to identify the source of epilepsy.[7] These memories ordinarily remain suppressed and subconscious, but in rare cases they invade awareness and cause "Hyperthymestic memory." This was first documented in a woman named Jill Price, who sought the help of memory experts at UC Irvine because she was continually distracted by childhood memories that disrupted her ability to function.[8,9] Some find this condition useful. For example, hyperthymestic memory enables the actress Marylou Henner to recall her acting scripts effortlessly. Mild forms of the condition explain "photographic memory" enjoyed by some students.

The Dreaming Mechanism

During Rapid Eye Movement (REM) sleep, a dreaming mechanism

automatically reviews memory records to identify dangerous environmental circumstances. During this dreaming activity the brain automatically prevents skeletal muscle activity that would otherwise cause violent activity during sleep.[10] This continual re-assessment of retained memory explains the phenomenon of "allostasis"—the ability of animals to gradually adapt their behavior to changing environmental circumstances.

The Emotional Mechanism

The emotional mechanism monitors consciousness and generates fear and anxiety when it detects dangerous environmental circumstances previously identified by the dreaming mechanism. This enables pre-emptive avoidance of environmental dangers. The fear and anxiety activate sympathetic nervous activity that releases HPA axis hormones (epinephrine, cortisol, glucagon, etc.) to facilitate pre-emptive "fight or flight."

Fight or Flight

The fight or flight mechanism combines the mechanisms of consciousness, memory, dreaming, and emotion to avoid environmental dangers, and optimize survival in life-or-death situations such as attacks by a predator. However, its activity is inherently wasteful, harmful, and even life-threatening. It generates sympathetic nervous activity that releases HPA hormones, elevates blood sugar, increases blood coagulability, undermines organ perfusion and oxygenation, and consumes and wastes glucose, fibrinogen, ATP, and other body substrates.

The fight or flight mechanism is powerful and dangerous. Once activated, it can cause lingering emotional activity that is difficult to extinguish. Chronic fear and anxiety exaggerate sympathetic nervous activity, which increases capillary gate activity,[11,12] accelerates capillary senescence, and generates abnormal

amyloid protein that deposits in tissues and promotes inflammation and sclerosis, undermines function, manifests as chronic illnesses, and undermines life span. Severe, acute fear and terror can be lethal, as in uninjured persons caught near the epicenter of earthquakes who suffer sudden death. Survivors exhibit increased heart disease, blood enzyme elevations, increased blood coagulability, and reduced life span.[13-20]

The fight or flight mechanism explains numerous "neurotic" phenomena such as the "Stockholm Syndrome" seen in kidnap victims and PTSD (Post Traumatic Stress Syndrome) suffered by soldiers. Children are particularly vulnerable because they cannot defend themselves when they are subjected to incest or excessive punishment, and this causes narcissism, criminal behavior, drug addiction, chronic illness, and emotional problems later in life.

Anesthesia and Consciousness

Both volatile inhalation anesthetics and sedatives, including beverage alcohol, inhibit consciousness in a dose-related manner, and beneficially abolish fear and anxiety. 100 years ago, George Washington Crile proved that potent pre-medication prevents untoward fear of surgery and improves surgical outcome.[21] Anesthesia undermines the ability to perceive nociception as pain even before it eliminates the ability to speak. This was commonly observed during the era of ether, and it conveyed the enduring assumption that inhalation anesthetics possess analgesic properties, which implies that inhibiting consciousness is the key to controlling nociception, pain, and surgical stress. However, such is not the case, because the spinal cord nociception pathways and sympathetic ganglia remain active despite the effects

of anesthesia and sedation. Worse yet, anesthesia abolishes the corticofugal (descending) inhibition of spinal cord nociception pathways. This indirectly hyper-activates spinal cord nociception pathways, and exaggerates harmful sympathetic activity that undermines tissue perfusion, tissue oxygenation, and organ protection during surgery.

Worse yet, uninhibited surgical nociception causes patients to spontaneously hyperventilate and deplete their tissue reserves of carbon dioxide. This dangerously undermines respiratory drive, disrupts oxygen transport and delivery to tissues, invites infarction. It creates a condition that is analogous to "Ondine's Curse" of Greek mythology, wherein the gods cursed Ondine with a condition that would cause her to die if she fell asleep. Similarly, CO_2 depleted patients appear to breathe normally after they emerge from anesthesia, but they may stop breathing and die if they fall asleep for any reason before they have replenished their CO_2 reserves. This often happens after recovering patients are treated with small doses of narcotics and sedatives that encourage sleep, so that the problem is typically attributed to "narcotic hypersensitivity."[22,23] This danger is further intensified in the presence of obstructive sleep apnea (OSA) and other obscure medical maladies, particularly when surgical patients are discharged home in the care of medically ignorant friends and family.

This problem of unexpected postoperative respiratory arrest and death is the first recognized safety issue of modern anesthesia. The phenomenon was famously investigated by Dr. Yandell Henderson, the Director of the Human Physiology Laboratory at Yale Medical School.[24] Dr. Henderson correctly identified the problem and recommended that patients breathe a mixture of 5% carbon dioxide and 95% oxygen during anesthesia to prevent CO_2 depletion. This not only eliminated the postoperative deaths, but also prevented unexplained intraoperative deaths.[24] During the same era Dr. George Washington Crile discovered that morphine supplementation of general anesthesia improves surgical outcome, and that massive morphine treatments can cure life-threatening bacterial sepsis and peritonitis without the need for antibiotics.[2] We can now appreciate that narcotics and hypercarbia go together like love and marriage during general anesthesia. Narcotic supplementation inhibits sympathetic hyperactivity, prevents hyperventilation that depletes CO_2, and promotes organ perfusion and oxygenation during surgery.[6] Hypercarbia counteracts narcotic respiratory depression, optimizes tissue oxygenation, accelerates narcotic metabolism and clearance, and protects postoperative respiratory drive.[25,26]

Unfortunately, the story does not end here. Dr. Ralph Waters, the founder of the MD anesthesiology profession, sought to ruin the reputation of the nurse-anesthetists who dominated anesthesia service after WWI, so that he could supplant them with his anesthesiology graduates. To accomplish this, he outrageously characterized carbon dioxide as "toxic waste, like urine" that must be "rid from the body" using mechanical hyperventilation during anesthesia. He devised devious animal studies[27] that confused asphyxiation with anesthesia and toxicity, and fabricated fictitious clinical reports to bolster his arguments.[28,29] Unfortunately, he was successful in these scandalous endeavors, and he established a hoax that has escaped the bounds of anesthesia and derailed medical progress ever since.[25,26]

100 years ago, George Washington Crile proved that potent pre-medication prevents untoward fear of surgery and improves surgical outcome.

The Tissue Disruption Pathway consists of tissue factor in extravascular tissues, blood borne enzyme factors VII, VIII, IX, and X, and the vascular endothelium, which isolates tissue factor from the blood enzymes.

Autonomic Balance

Sympathetic nervous activity releases von Willebrand Factor hormone from the vascular endothelium, which closes the capillary gate and restricts blood flow to organs and tissues.

Parasympathetic nervous activity releases nitric oxide hormone from the vascular endothelium to open the capillary gate, and increase blood flow to organs and tissues. Autonomic balance thus regulates organ perfusion, which determines organ function. Consciousness affects autonomic balance, but autonomic activity persists in its absence.

Epinephrine and Insulin

Epinephrine and Insulin are opposing hormones that extend autonomic balance to peripheral muscles and tissues, where direct autonomic innervation is lacking. Sympathetic activity releases epinephrine from the adrenal gland, and epinephrine releases von Willebrand Factor from the vascular endothelium to close the capillary gate. Parasympathetic nervous activity releases insulin from the pancreas, and insulin releases nitric oxide from the vascular endothelium to open the capillary gate.[12]

Brain Astrocytes

Brain tissue is replete with "support cells" called astrocytes that secrete TPA (tissue plasminogen activator) that maintains brain perfusion and oxygenation despite massive doses of epinephrine that are administered for cardiopulmonary resuscitation. Otherwise, severe sympathetic hyperactivity causes or contributes to harmful organ and tissue hypoxia.

The Tissue Disruption Pathway

The Tissue Disruption Pathway activates tissue repair. It consists of tissue factor in extravascular tissues, blood borne enzyme factors VII, VIII, IX, and X, and the vascular endothelium, which isolates tissue factor from the blood enzymes.

Tissue Maintenance

The vascular endothelium is "selectively permeable" so that it allows the slow "penetration" of blood enzyme factor VII into extravascular tissues, where tissue factor enables its enzymatic activity, which generates small amounts of thrombin to energize slow fibroblast collagen generation tissue that enables tissue maintenance throughout the body.

Capillary Gate Function

The vascular endothelium simultaneously allows the slow "escape" of tissue factor into flowing blood, where it activates factor VII. Since factor VII activity is essential for the activity of factors VIII, IX and X, this enables continuous low levels of blood enzyme activities necessary for capillary gate function, which regulates cardiac output, blood flow distribution, and organ function.

Tissue Repair

Tissue damage disrupts the vascular endothelium and exposes tissue factor to VII, which stabilizes factor VII and enables its enzymatic activity. Since the other enzymes remain inert in the absence of factor VII activity, the activation of factor VII acts as a trigger that initiates the enzymatic interaction of factors VII, VIII, IX, and X, and determines its magnitude and location. The resulting enzyme activity generates thrombin to energize the conversion of fibrinogen into insoluble fibrin that binds blood cells into a viscoelastic clot, which substitutes for the damaged vascular endothelium and re-isolates blood enzymes from the damaged tissues beneath its protective surface. The gigantic size of factor VIII prevents it from

penetrating the viscoelastic clot, which automatically limits clot formation to the immediate vicinity of tissue damage and prevents dangerous systemic coagulation. The viscoelastic clot is "selectively permeable" so that it governs the access of blood enzymes to the damaged tissues, and thereby regulates thrombin generation in the damaged tissues to energize cellular repair activities and prevent excessive thrombin generation that threatens malignancy. Toxic substances can promote disease and malignancy by exaggerating the permeability of the vascular endothelium and the viscoelastic clot.

The vascular endothelium is specialized to serve the requirements of organs and tissues, as illustrated in figure 2.

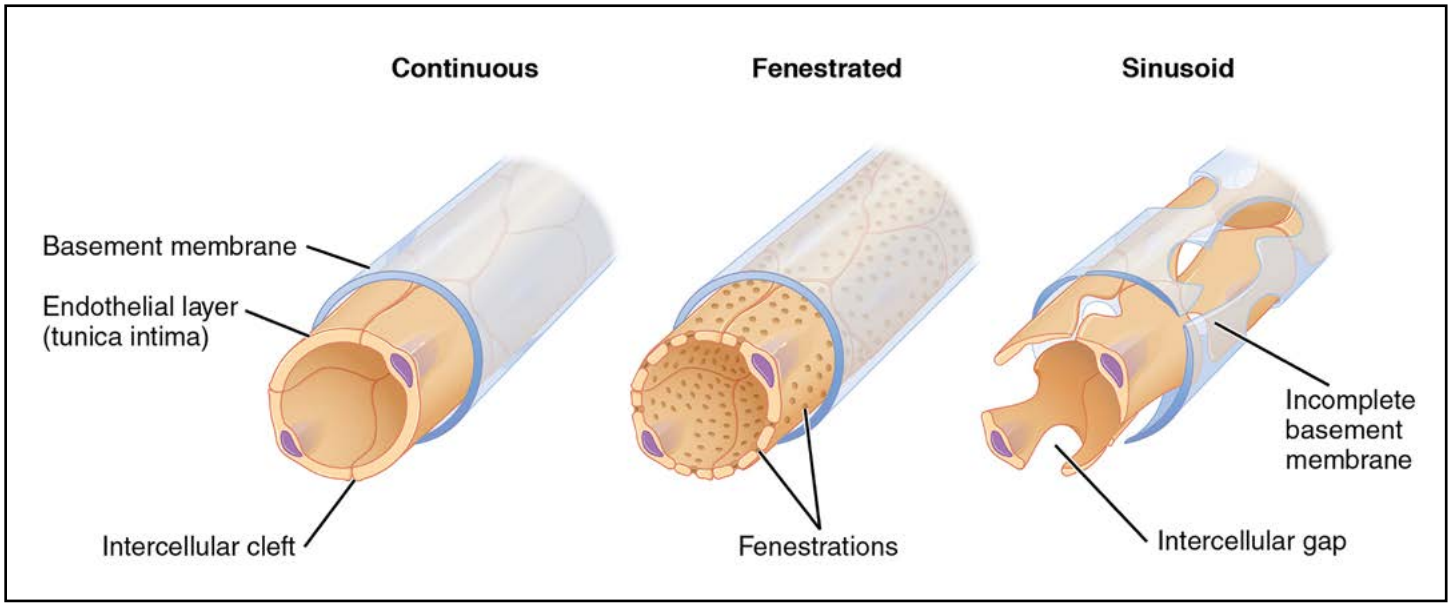


Figure 2 The Vascular Endothelium is sub-specialized to serve the requirements of various organs and tissues. Its cells are joined tightly together in brain tissue, which explains the so-called "blood-brain barrier." It is "sinusoid" in the liver to facilitate the absorption of lipoproteins and toxic substances.

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Radiation

Radiation and toxic chemicals do not disrupt the vascular endothelium, but they increase its permeability, which allows the penetration of factors VII and X into irradiated tissues, where they generate thrombin that energizes inflammation that exaggerates nociceptor sensitivity, causing sunburn pain.

Toxic Chemicals

Like radiation, toxic chemicals alter the permeability of the vascular endothelium and allow leakage of tissue factor into systemic circulation, which exaggerates blood coagulability. They also directly disrupt cellular organ function.

Sepsis

Invasive bacteria that enter the bloodstream trigger the "complement cascade" enzymes that rapidly generate thrombin to energize immune activity to attack the bacteria. The elevated thrombin levels open gaps between the cells of the vascular endothelium, which increases its permeability and exaggerates the escape of tissue factor into systemic circulation. The tissue factor activates factor VII, causing "positive feedback" that dangerously exaggerates systemic inflammation and blood coagulability.

Tissue Factor

Tissues vulnerable to bleeding are rich in tissue factor, which is consistent with its role in hemostasis and tissue repair. These include brain, spinal cord, retina, nerves, autonomic ganglia, lung, gonads, cervix, placenta, amniotic fluid, epithelium, renal glomeruli, and fibroblasts.[30] This explains why the lung and brain are "target organs" that are first to exhibit distress with the onset of critical illnesses including ARDS, MOFS, SIRS,

and eclampsia, and why these same organs are vulnerable to both primary and metastatic malignancy. Brain trauma allows tissue factor to escape from the brain into systemic circulation, causing systemic inflammation and hypercoagulability. Smoking is especially dangerous because delicate lung tissue is replete with tissue factor.

Conclusion

In my future essays I will explain the nature and difference between chronic and critical illnesses, and how stress theory confers powerful new treatment strategies that promise cures for everything from cancer to the common cold. Knowledge is power. Those who wish to learn more about stress theory and its implications are encouraged to explore the author's website www.stressmechanism.com, which offers free downloads of his published papers, and read his recently published book called "50 Years Lost in Medical Advance: The Discovery of Hans Selye's Stress Mechanism" that is published by the American Institute of Stress.

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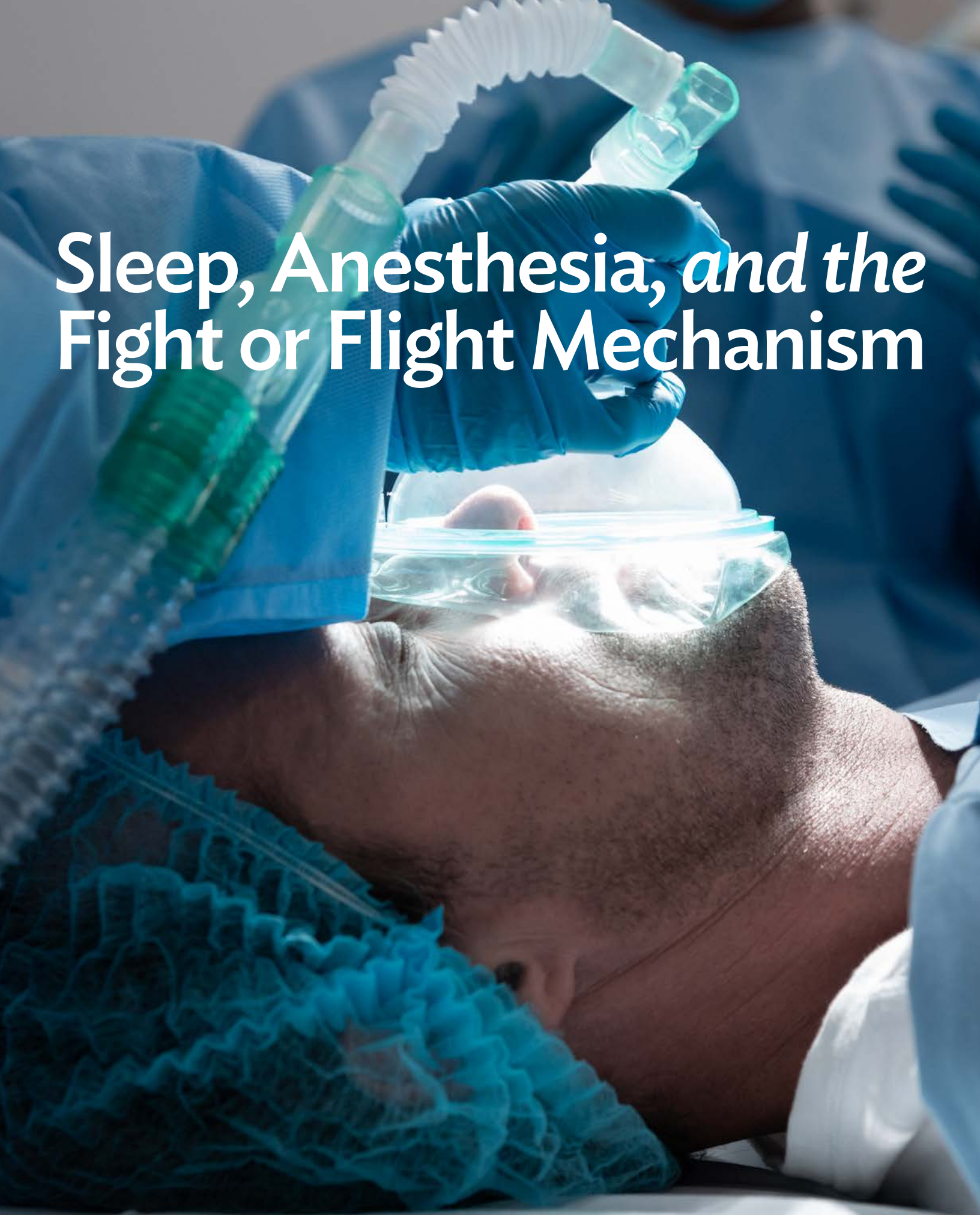
Lewis Coleman, MD, FAIS *is a board-certified anesthesiologist who completed his BS degree in biology at Ohio State University, earned his MD degree from New York Medical College, and completed his surgical internship and anesthesiology residency at UCLA, followed by 40 years in private practice. Coleman's basic sciences instruction at NYMC miraculously coincided with the two-year sojourn of Dr. Johannes Rhodin, a famous Swedish pioneer of electron microscopy who was retained by the school to upgrade its curriculum. Dr. Rhodin was an expert on the stress theory of Hans Selye. His stress theory lectures devastated the dogma of classical physiology and convinced Coleman that stress theory represented the future of medicine. Many years later, these lectures miraculously enabled Coleman to identify Selye's long-sought stress mechanism. Thus identified, the stress mechanism enables Selye's "Unified Theory of Medicine" that promises a new era of health, longevity, and freedom from the eternal curse of disease. Its implications exceed the bounds of medicine and confer a "unified theory of biology" that explains embryology, extinction, evolution, ethology, intelligence, anatomy, taxonomy, the Cambrian explosion, and dinosaurs, and resolves the disparities of Darwin, Lamarck, Baldwin, and saltation. Its distant implications reside in the realm of science fiction. His website http://www.stressmechanism.com is dedicated to stress theory and offers relevant materials free of charge. His book, 50 Years Lost in Medical Advance: The Discovery of Hans Selye's Stress Mechanism, is available on Amazon.*

Sleep, Anesthesia, *and the* Fight or Flight Mechanism



By Lewis Coleman, MD, FAIS

Emotions are powerful and painful. We seek solace from them in the form of alcohol, tranquilizers, vacations, psychotherapy, religion, and counseling. It's common knowledge, backed by abundant evidence, that emotional pain is not only unpleasant, but also harmful to health. Nevertheless, exactly how and why emotions are harmful has remained a stubborn mystery. This essay will review the surprising similarities of sleep and anesthesia from the perspective of stress theory to illustrate the nature of emotional stress and explain how and why it causes disease and devastates health.

Alcohol is the anesthesia by which we endure the operation of life.

– George Bernard Shaw

Sleep

Sleep, that knits up the ravell'd sleave of care — Shakespeare, Macbeth

Sleep is essential for life, and it is vaguely assumed to conserve energy, relieve stress, and optimize brain function, but its purpose has never been clear. Stress theory confers a fresh explanation that is consistent with known science: sleep enables the "fight or flight" mechanism that enhances survival by pre-emptively detecting dangerous environmental circumstances, inducing fear and anxiety that facilitates flight from the danger, and optimizing fighting ability when flight fails to avoid life-threatening confrontations in the wild.[1,2]

The Fight or Flight Mechanism

The "fight or flight" mechanism consists of four sub-mechanisms that work together:

1. ***Consciousness*** interprets nervous sensory information as sight, sound, smell, taste, and touch. It interprets nociception as pain.
2. The ***memory mechanism*** records and retains an audio-visual record of all waking moments throughout life, and works closely with consciousness to produce a cohesive perception of the surrounding environment.
3. The ***dreaming mechanism*** automatically reviews accumulating memories during sleep to identify dangerous environmental circumstances.
4. The ***emotional mechanism*** induces fear and anxiety that activates sympathetic nervous system hyperactivity to facilitate fight or flight when consciousness detects dangerous environmental circumstances previously identified by the dreaming mechanism.

The fight or flight mechanism explains clinical psychology. Though its survival role in humans is minimal, it affects human emotion, pathophysiology, and behavior in countless ways. It explains

It's common knowledge, backed by abundant evidence, that emotional pain is not only unpleasant, but also harmful to health.

PTSD (post-traumatic stress disorder), the "Stockholm Syndrome," voodoo death,[3] drug addiction, alcoholism, the lingering effects of childhood abuse, criminal behavior, and the "social behavior" of both humans and animals that causes them to instinctively form hierarchies, tribes, and governments.[4] It explains how emotion induces harmful sympathetic nervous activity that elevates blood pressure and pulse rate, releases stress hormones, and promotes harmful stress mechanism hyperactivity that causes disease.

The fight or flight mechanism causes stress mechanism hyperactivity that consumes and wastes body resources, and produces harmful excesses and defective versions of its products.

Though the fight or flight mechanism enhances survival, it is innately harmful. It causes stress mechanism hyperactivity that consumes and wastes body resources, and produces harmful excesses and defective versions of its products. It diverts blood flow to some organs at the expense of others. It induces sympathetic nervous system hyperactivity, which releases von Willebrand hormone that consumes fibrinogen to generate insoluble fibrin that increases blood coagulability, and exaggerates microvascular flow resistance.[2,5,6] This minimizes blood loss in the event of injury, and diverts blood flow and oxygen to the heart and brain. Sympathetic activity also releases HPA "stress hormones" such as glucagon, cortisol, and epinephrine that elevate cellular metabolism and convert glycogen to glucose to increase blood glucose levels.

Extreme sympathetic hyperactivity can precipitate heart attacks, strokes, and sudden death. Prolonged, subacute sympathetic hyperactivity accelerates amyloidosis, atherosclerosis, capillary senescence, and systemic inflammation, which causes heart disease, cancer, chronic illnesses, and premature death. My favorite example is the earthquake studies of Kario et al. that demonstrated how uninjured people near the epicenter of the earthquake suffered higher rates of sudden death than those far away. Uninjured survivors exhibited elevations in blood coagulability, von Willebrand Factor, and factor VIII activity for months.[7–15]

Nociception and Sympathetic Nervous Activity

Nociception is nervous activity generated by tissue disruption sensors called "nociceptors" that are located in organs and peripheral tissues. Peripheral sensory nerves conduct nociception to specialized nociception pathways in the spinal cord. The spinal cord conducts nociception simultaneously to the brain AND to sympathetic nervous ganglia in the chest and abdomen.

The sympathetic ganglia convert nociception into sympathetic nervous activity, and they directly innervate internal organs including the brain, heart, lungs, adrenal glands, and the GI tract. The sympathetic nervous activity increases blood coagulability and controls the capillary gate[2,5] to govern blood flow.[2, 14] The adrenal glands release HPA hormones including glucagon, which elevates blood glucose, and epinephrine, which closes the capillary gate in peripheral tissues that are not directly innervated by sympathetic ganglia.

Corticofugal Control of Nociception

The cerebral cortex generates consciousness, which interprets nociception as pain. Consciousness regulates nociception in accord with emotion via descending ("corticofugal") inhibitory nervous pathways from the cerebral cortex to spinal cord nociception pathways.[16] Thus, consciousness regulates both sympathetic nervous activity and the perception of pain. This facilitates fight or flight despite injury in life-threatening situations. The classical example is a

soldier who suffers a severe wound during fearsome combat but remains unaware of the pain while he continues to fight. When the combat subsides, he suddenly becomes aware of the excruciating pain caused by his injury.

Anesthesia extinguishes consciousness, which eliminates its inhibition of nociception. This has the unfortunate effect of exaggerating harmful sympathetic nervous hyperactivity induced by surgical nociception unless anesthesia is supplemented with analgesia.

Analgesia beneficially inhibits nociception. This prevents pain, but has no effect on consciousness, so the fight or flight mechanism can still be activated by other senses.

Nociception and Respiratory Drive

Specialized nociceptors called "respiratory chemoreceptors" enable respiratory drive, which stimulates breathing. There are three sources of respiratory drive:

1. ***Primary respiratory drive*** dominates breathing in the presence of consciousness. Carbon dioxide reacts weakly with water to form a harmless acid called carbonic acid. This causes blood to be mildly acidic. Blood pH rapidly equilibrates with cerebrospinal fluid, and primary respiratory pH chemoreceptors located in the brain ventricles thus stimulate breathing in accord with CO_2 levels within the body. However, both sleep and anesthesia extinguish consciousness and paralyze primary respiratory drive.
2. ***Secondary respiratory drive*** sustains breathing in the absence of consciousness, during either sleep or general anesthesia. Its chemoreceptors are strongly sensitive to hypercarbia, and weakly sensitive to hypoxia. They are less sensitive than the primary chemoreceptors, so carbon dioxide levels are harmlessly elevated during normal sleep. The resulting hypercarbia has little effect on hemoglobin saturation in arterial blood. Instead, it lowers microvascular flow resistance, enhances cardiac efficiency, speeds the transport of oxygenated blood from the lungs to organs and tissues, and enhances the release of oxygen from blood into tissues. Mild hypercarbia during sleep thus optimizes oxygen transport and delivery. In contrast, hyperventilation depletes CO_2 tissue reserves, which paralyzes secondary respiratory drive chemoreceptors. This creates a dangerous

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condition similar to "Ondine's curse" in Greek Mythology. The Gods cursed Ondine so that she would stop breathing and die if she ever fell asleep.

3. ***Nociception*** directly stimulates breathing despite general anesthesia. During anesthesia, this can cause hyperventilation that depletes CO_2 body reserves and paralyzes secondary respiratory drive. Supplementation of general anesthesia with narcotic analgesia inhibits surgical nociception, prevents hyperventilation and CO_2 depletion during surgery, and protects postoperative respiratory drive.

Memory

Our brains possess a memory mechanism that records and retains vivid audiovisual records of all waking moments throughout life, including infancy. These memories are normally suppressed, so that most people are unaware of them. This startling phenomenon was accidentally discovered by Dr. Wilder Penfield, a neurosurgeon who stimulated the brains of awake patients with weak electrical currents while attempting to find better ways to treat epilepsy.[17] More recently, a woman named Jill Price sought the help of memory experts at UC Irvine because her consciousness was flooded with vivid childhood memories that disrupted her ability to function.[18] They gave her condition a name: "Hyperthymestic syndrome."[19] Since then, several similar patients have been identified. For example, the actress Marilu Henner of "Taxi" fame recalls her acting scripts effortlessly.

Dreaming

The dreaming mechanism provides the key to understanding how the fight or flight mechanism works. There are three "stages" of sleep. Dreaming occurs during the third stage, which is called "deep sleep" or "REM" (rapid eye movement) sleep.[20] During dreaming, brain activity approaches awake levels and the body experiences temporary paralysis of voluntary muscles, with the exception of eye and breathing muscles. This prevents violent movements related to the dreaming process. The dreaming mechanism reviews memories during REM sleep to identify dangerous environmental circumstances. Sometimes there is inadequate paralysis of the skeletal muscles, which causes "Rapid Eye Movement (REM) Sleep Behavior Disorder" while people are acting out their dreams. This can manifest as small twitches and leg movements, sleepwalking, or even violent attacks on sleeping companions.[21]

Obstructive Sleep Apnea

In patients with abnormal airway anatomy, pharyngeal muscle relaxation during REM sleep can cause soft tissues to collapse into the airway and obstruct air flow. This is called "obstructive sleep apnea (OSA)." This becomes extremely dangerous when patients with abnormal airway anatomy are hyperventilated during anesthesia, because this depletes CO_2 body reserves, and paralyzes secondary respiratory drive during general anesthesia.[22,23] Such a patient may regain consciousness,

which restores primary respiratory drive after anesthesia, but the combination of abnormal anatomy and inadequate respiratory drive is a prescription for disaster, especially is sent home in the care of medically ignorant friends and family.[22,24-30]

Emotion

The emotional mechanism works closely with consciousness to pre-emptively perceive dangerous environmental circumstances previously identified by the dreaming mechanism, whereupon it induces fear and anxiety, which activates sympathetic nervous activity that increases blood coagulability, diverts blood flow to heart and brain, and releases HPA "stress" hormones. This enhances survival by causing animals to flee from dangerous circumstances, and simultaneously enhancing survival in the event of life-threatening encounters.

Anesthesia and the Fight or Flight Mechanism

Today it is forgotten that before the discovery of anesthesia, surgery was not only excruciatingly painful, but also was plagued by a "surgical stress syndrome (SSS)" that worsened inexorably during the two days following successful surgery, and often culminated in agonizing death. It consists of symptoms distant from the time and site of surgery, including fever, tachycardia, hypertension, exaggerated pain, delirium, dementia, and organ failure. This syndrome was so fearsome that most physicians avoided surgery.

Anesthesia was considered miraculous because it prevented the perception of surgical pain and mitigated the life-threatening effects of the SSS enough to enable most patients to survive life-saving surgery, but the SSS persists despite anesthesia in the form of acute renal failure, atelectasis, pneumonia, bowel ileus, heart attacks, strokes, delirium, and dementia. Its distant effects include increased cancer, heart disease, and chronic illnesses.

Anesthesia inhibits the SSS by paralyzing the fight or flight mechanism. It eliminates the ability of consciousness to perceive pain and danger, generate fear, and exaggerate harmful sympathetic nervous activity. However, anesthesia alone cannot abolish surgical stress. It doesn't inhibit spinal cord nociception pathways that activate harmful sympathetic nervous activity independent of brain activity. Worse yet, it paralyzes the descending cortical pathways that inhibit spinal cord nociception. This has the unfortunate effect of exaggerating spinal cord nociception pathway activity induced by surgery that elevates harmful sympathetic nervous system activity. This jeopardizes organ safety, and induces hyperventilation that depletes CO_2 body reserves, undermines respiratory drive, and threatens unexpected postoperative respiratory arrest.

The depletion of CO_2 tissue reserves deserves special attention, because CO_2 is so widely misunderstood. CO_2 is persistently vilified in the mass media as a supposed cause of "global warming" and as a "toxic waste gas" that must be "rid from the body." This represents scientific and cultural insanity, because nothing could be further from the truth. CO_2 is benign, beneficial, and essential for life. It is as essential as oxygen, because it enables all aspects of the mechanism of oxygen transport and delivery that captures oxygen from the atmosphere and delivers it to cells deep within the animal body. Those who wish to know more can begin with my published review of CO_2 pathophysiology called "Four Forgotten Giants of Anesthesia History that can be downloaded from the Internet free of charge.[31]

CO_2 depletion undermines primary

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respiratory drive, and paralyzes secondary respiratory drive altogether, causing a deceptive and dangerous condition called the "hyperventilation-hypoventilation syndrome."[32] CO2 depleted patients emerging from surgery appear to breathe normally after they regain consciousness, which restores primary respiratory drive that resists CO2 depletion. However, the CO2 depletion inhibits the release of oxygen from blood into tissues and organs. The resulting hypoxia causes postoperative heart attacks, strokes, atelectasis, bowel ileus, nausea, vomiting, and pneumonia.

Even scarier, if patients fall asleep in this dangerous condition, they may suffer sudden, unexpected respiratory arrest because sleep extinguishes primary respiratory drive, and secondary respiratory drive remains paralyzed by CO2 depletion.[33,34] This problem caused considerable consternation during the early days of modern anesthesia, and became the first recognized anesthetic safety issue.[23] Amazingly, this problem persists to the present, even though its cause has been understood for more than 100 years, and continues to kill countless patients. The problem is commonly attributed to narcotics, which beneficially prevent harmful surgical nociception.[33-36]

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Analgesia

Like anesthesia, analgesia is stress control. Analgesics inhibit stressful surgical nociception, which prevents pain, but they don't otherwise affect brain activity, so they don't eliminate the fight or flight mechanism.

There are three types of analgesics:

1. ***Narcotics*** inhibit spinal cord nociception pathways. These are virtually devoid of toxicity but they cause respiratory depression that is readily counteracted by beneficial hypercarbia. They are devoid of toxicity, and they offer the most practical, predictable, safe, and reliable means to prevent harmful surgical nociception.
2. ***NSAIDs*** (Non-Steroidal Anti-Inflammatory Drugs) inhibit nociceptors. These are inherently toxic and often lethal, especially when used for prolonged periods at high doses to control pain.
3. ***Local analgesics*** such as lidocaine inhibit nociception by blocking nociceptors, peripheral nerves, and spinal cord nociception pathways. Compared to narcotics, they are toxic and unpredictable.

Optimizing Anesthetic Management

Stress theory postulates three synergistic pathways that activate the stress mechanism:[2]

1. ***Cognitive pathway,*** which encompasses the mechanism of fight or flight. Anesthesia controls this pathway.
2. ***Nociception pathway,*** which consists of nociceptors that generate nociception, and the peripheral nerves and spinal cord pathways that conduct nociception to the brain and sympathetic ganglia. Analgesics control this pathway.[37]
3. ***Tissue disruption pathway,*** which consists of blood-borne enzyme factors VII, VIII, IX and X that are isolated from tissue factor in extravascular tissues by the vascular endothelium. This pathway is activated by surgical tissue disruption that exposes tissue factor to the blood enzymes. At present there is no treatment available to control this pathway.

Surgery activates all three of these pathways, causing stress mechanism hyperactivity that manifests as the surgical stress syndrome (SSS). It is presently impossible to eliminate the SSS altogether, because there is no available treatment to control the tissue disruption pathway. However, synergistic combinations of

anesthesia, analgesia, and hypercarbia can produce a beneficial state that mimics normal sleep, minimizes the SSS, and optimizes safety and outcome better than either anesthesia or analgesia alone. The anesthesia abolishes consciousness and paralyzes the dangerous fight or flight mechanism. The narcotic analgesia inhibits surgical nociception. The hypercarbia mitigates microvascular flow resistance, optimizes organ perfusion, and releases oxygen from arterial blood to elevate tissue oxygenation. My book provides a detailed explanation of this technique.[6]

Unfortunately, anesthesia practice is presently dominated by a set of counter-productive beliefs and assumptions that undermine safety and outcome and have cost the lives and longevity of countless patients. These superficially reasonable dogmas include the following:

1. ***Blood pressure is the "driving force" of blood flow, tissue perfusion, and tissue oxygenation.***[38] If this be so, then why does blood pressure vary from point to point throughout the arterial tree?[39] Why is atherosclerosis absent in distal arterioles, and why does it appear first in the bifurcations and greater curvatures of large proximal arteries such as the aorta and carotids? Conventional theory cannot explain this.
2. ***Low blood pressure implies impending disaster, while high blood pressure indicates healthy "cardiac reserve."*** On the contrary, high blood pressure is invariably associated with low cardiac output, poor tissue perfusion, limited exercise tolerance, and tachycardia. In contrast, trained athletes exhibit abnormally low blood pressure at rest and normal blood pressure during exercise. Synergistic combinations of anesthesia and analgesia beneficially lower blood

Synergistic combinations of anesthesia, analgesia, and hypercarbia can produce a beneficial state that mimics normal sleep, minimizes the SSS, and optimizes safety and outcome better than either anesthesia or analgesia alone.

pressure by reducing microvascular flow resistance and optimizing tissue and organ perfusion, but excessive levels of toxic inhalation agents lower blood pressure by inhibiting cardiac contractility.

3. ***"Vasopressor" drugs enhance cardiac output, tissue perfusion, and tissue oxygenation by elevating blood pressure.*** These drugs are routinely used to treat hypotension, but they have never demonstrated any ability to improve cardiac output, tissue perfusion, tissue oxygenation, or outcome. Instead, they elevate blood pressure by closing the capillary gate and increasing microvascular flow resistance, which undermines tissue perfusion and oxygenation.
4. ***The heart is the "Charles Atlas" of the body that drastically increases its contractile force to increase its output ten-fold during intense exercise.***[38] This was the imaginary notion of Walter B. Cannon, a WWI Harvard researcher. In reality, cardiac contractility is so weak that it can barely propel blood to the top of the head, which explains why vertebrate heads are located only a short distance above the heart. The secret of exercise tolerance is the non-Newtonian nature of mammalian blood, which eliminates turbulent flow resistance and optimizes cardiac efficiency.[2,6]
5. ***Anesthetic inhalation agents have analgesic properties***. This is founded on the observation that inhalation agents eliminate the ability of consciousness to perceive nociception as pain before they abolish the ability to speak. True analgesics inhibit nociception and prevent harmful sympathetic nervous hyperactivity, but inhalation agents possess no such ability.
6. ***Carbon dioxide is "toxic waste, like urine, that must be rid from the body."*** This is a quote from Dr. Ralph Waters, the founder of the MD Anesthesiology profession, who sought successfully to tarnish the reputation of the nurse-anesthetists who dominated anesthesia service after WWI.[31] Unfortunately, his destructive influence persists in anesthesia practice, and has permeated medicine in general.

Because of these flawed beliefs and assumptions, anesthetists are trained to hyperventilate their patients, which dangerously depletes CO_2 tissue reserves, and avoid beneficial narcotics that prevent harmful nociception.[40-45] They use paralyzing agents to promote surgical convenience by preventing muscle tension and untoward movements caused by "spinal cord windup" during surgery. As a result, uncontrolled sympathetic hyperactivity exaggerates the morbidity and mortality of the SSS.[46] Anesthesiology residents are taught to employ mechanical hyperventilation to eliminate carbon

dioxide. This deceptively exaggerates pulse oximeter readings but simultaneously inhibits tissue and organ perfusion and oxygenation.[47] It also undermines respiratory drive and causes unexpected postoperative respiratory arrest.[32-34] Those interested may learn how these dogmas became entrenched in anesthesia practice by reading either my paper entitled "Four Forgotten Giants of Anesthesia History"[31] or my book entitled "Fifty Years Lost in Medical Advance."[6]

Conclusion

The fight or flight mechanism is the "Ghost in the Machine" hypothesized by Arthur Koestler.[48] It provides a unified theory of psychology that explains the purpose of sleep, emotion, memory, and their relationships to physiology and disease. In animals it explains ethology. However, much work remains to be done to clarify the operations of these mysterious mechanisms.

The fight or flight mechanism is a sub-component of the mammalian stress mechanism. It exemplifies the extended implications of stress theory which characterize all powerful theories. It is undoubtedly shared in similar form by the stress mechanisms of other vertebrate classes. The discovery of the mammalian stress mechanism explains how stress theory works, and thereby enables the "unified theory of medicine" that Hans Selye anticipated. It explains the nature of disease, and provides revolutionary, reliable treatments and guided research that promises a new era of human existence that is free from disease and premature death. It further implies a "unified theory of biology" that explains embryology, ethology, evolution, taxonomy, the Cambrian Explosion, dinosaurs, and the nature and origin of life. It also resolves the disparities of Darwin, Lamarck, Baldwin, and Saltation, and paves the path to altering evolution at will, with results that reside in the realm of science fiction.[6]

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Lewis Coleman, MD, FAIS *is a board-certified anesthesiologist who completed his BS degree in biology at Ohio State University, earned his MD degree from New York Medical College, and completed his surgical internship and anesthesiology residency at UCLA, followed by 40 years in private practice. Coleman's basic sciences instruction at NYMC miraculously coincided with the two-year sojourn of Dr. Johannes Rhodin, a famous Swedish pioneer of electron microscopy who was retained by the school to upgrade its curriculum. Dr. Rhodin was an expert on the stress theory of Hans Selye. His stress theory lectures devastated the dogma of classical physiology and convinced Coleman that stress theory represented the future of medicine. Many years later, these lectures miraculously enabled Coleman to identify Selye's long-sought stress mechanism. Thus identified, the stress mechanism enables Selye's "Unified Theory of Medicine" that promises a new era of health, longevity, and freedom from the eternal curse of disease. Its implications exceed the bounds of medicine and confer a "unified theory of biology" that explains embryology, extinction, evolution, ethology, intelligence, anatomy, taxonomy, the Cambrian explosion, and dinosaurs, and resolves the disparities of Darwin, Lamarck, Baldwin, and saltation. Its distant implications reside in the realm of science fiction. His website http://www.stressmechanism.com is dedicated to stress theory and offers relevant materials free of charge. His book, 50 Years Lost in Medical Advance: The Discovery of Hans Selye's Stress Mechanism, is available on Amazon.*

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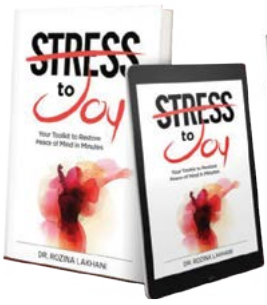


Sleep: Can't Live Without It

By Jeff Jernigan, PhD, FAIS

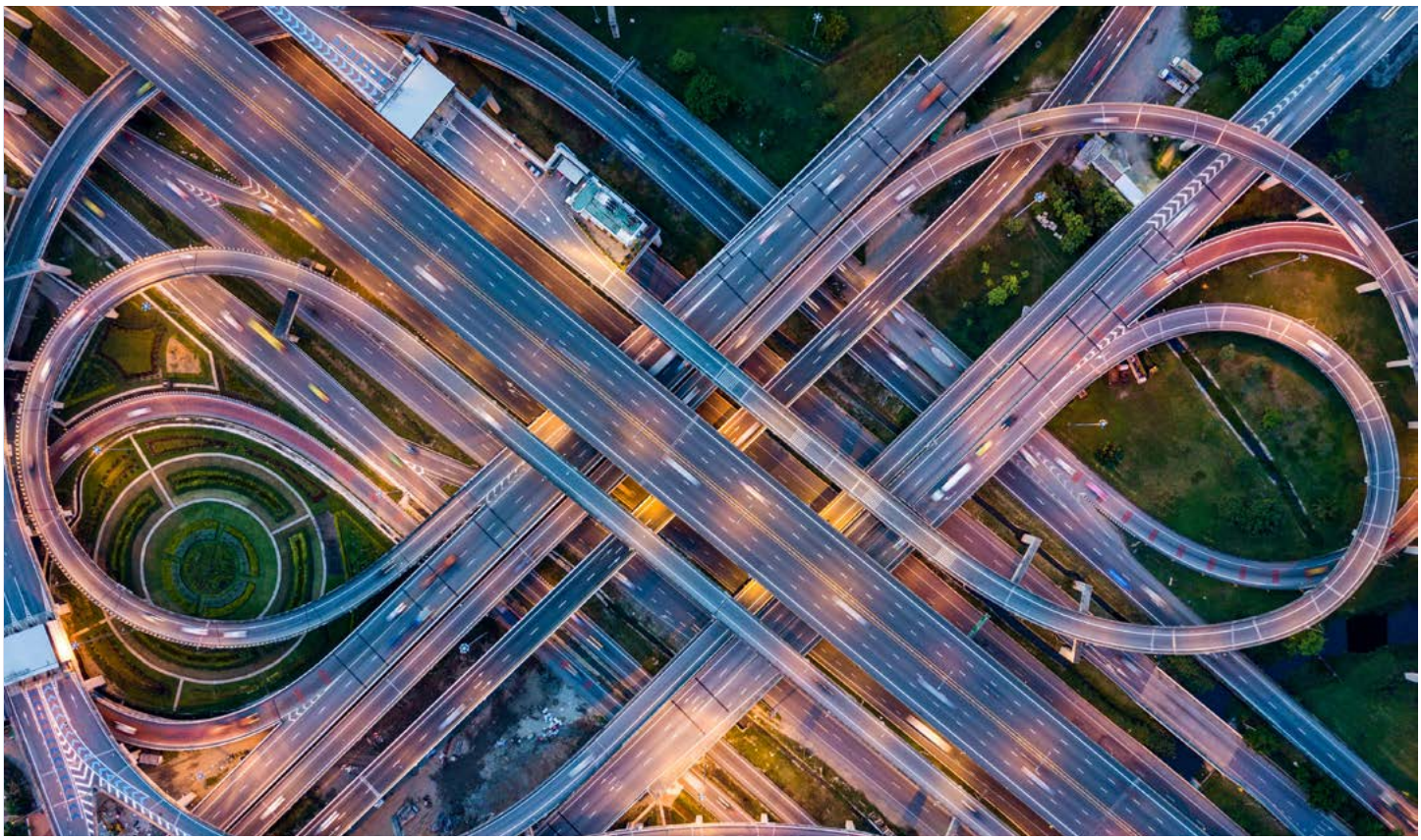
The class was getting frustrated. Every answer they gave was shot down by me. Little did they realize this was an intentionally created readiness learning moment. Or at least I hoped it would be. There were three points to make: our tendency is to make things too complicated; we look for absolute solutions first without sufficient reflection; and (if I could get them worked up enough) our own frustration at not coming up with the correct answer narrows and clouds our own thinking. The right answer to the question is SLEEP.

Now, we can go back to the beginning where the question was first asked.

This was a neurobiology class for soon-to-be professional counselors, coaches, and therapists. The question was simple, "Given the following symptoms, what is wrong with this client?" Here are the symptoms: discouragement, anxiety, tunnel vision, cloudy thinking, memory loss, poor decision making, emotional variability, paranoia, exaggerated startle response, fatigue, loss of some motor control, and a mysterious rash. The answers ranged from Lime Disease to Lupus to a number of sophisticated disorders. Fortunately, the client had a history of lack of sleep,

interrupted sleep, and inability to sleep… all of which explain this constellation of symptoms.

The client's problem is not unusual. Insufficient sleep has an estimated economic impact of over $411B each year in the United States[1] 35% of all adults in the US report on average sleeping less



than seven hours per night.[2] Less sleep means less physical and mental health.[3] What is it we need to understand about the biology of sleep that can help us sustain physiological and psychological health? Here are some mind and body basics we should consider first when we share many of the same symptoms as the client above.

Sleep is a complex result of genetic, biological, and cellular interaction and involves a number of structures in the brain.[4] These include the basal forebrain, thalamus, and hypothalamus which are involved in regulating sleep responding to signals between multiple structures in the brain.[5] No need to remember these names. Just think of the worst concentration of freeway overpasses, on-ramps, off-ramps, and signage stacked in multiple layers in any major metropolitan city and you will get the idea. Lots of things impact sleep. At this point, just keep in mind that the brain is key to everything.

Nutrition, exercise, and sleep are vital to good brain health. Without a healthy brain, sleep will run away from you like night runs away from a sunrise. There are a lot of things that can interrupt sleep: getting up to attend a child, nightmares, a loud noise in the house or outside that bears investigation, an upset stomach, sports injury, or the neighbor's late-night party. These are natural interruptions that can be a nuisance but don't necessarily affect your health negatively. Poor nutrition, insufficient exercise, and lack of sleep due to other causes like worry, anxiety, stress, and trauma can and do cause sleep problems.

Most of the neurotransmitters our brain needs for optimal operation are produced from the food we eat.[6] Exercise produces an enzyme which triggers a brain clean-up function *only* while we sleep.[7] Interrupted sleep and lack of sleep impairs this biological process and produces foggy-headed cognition as a result. Neurotransmitters that enable the different structures of the brain to communicate with each other are produced in our gut.[8] The most important part of the brain regulating sleep duration is the hypothalamus.[9] The results of a poor diet over time and lack of regular exercise decrease the ability of the hypothalamus to promote sleep.[10] Our mind and body are interactively engaged when it comes to sleeping well. Sleep seems so natural that many are surprised at so many factors must come together in the right way at the right time for a good night's sleep.

There are other causes for poor sleep besides a poor diet and lack of exercise: nightmares not attributed to physical cause like loud noises, too much pizza, or pain; interruptions of the Circadian Rhythm; and moral stress in the present and/or moral injury in the past. We will look at each of these categories next. A note of caution here: if your nutrition, exercise, and sleep patterns are messed up, it may be difficult to determine if any of these non-physical causes of sleep problems are at fault. Often, sleep problems are a set of interrelated factors, both biological and psychological, that need to be understood.

Dreams are a natural product of our physiology and psychology, playing a healthy role in our lives.[11] Dreams can be responses to our external environment. For example, a noise heard in the night that does not fully awaken us but requires a rational explanation may be processed in a dream. Dreams can also be a response to our internal environment: too much pepper on too much pizza that we had for dinner that is now talking back to us with discomfort. Again, it is a physical stimulus for which our minds require an explanation, using imagination and creativity to produce an

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answer. Dreams are also a mechanism for working out solutions to problems while we sleep.

Often, our subconscious mind shifts into problem-solving mode while we sleep but is missing a few pieces of the puzzle. When we sleep problem-solving can be more difficult than in awake states because working memory (where conscious thought occurs) must access short term and long-term memory, as well as other functions in our brain that may be off-line. When there is a mix-up, our mind will borrow a bit of recollection from something else and slip it into the empty spot it is trying to fill.[12] This can create some very interesting associations in our dreams. This hiccup in trying to rationalize our thoughts while sleeping happens because our brains work differently, in some respects, while we are asleep. Some functions in our brain go into their own sleep mode like our computers do when we don't want to shut them down entirely. For example, while we sleep and dream, our brains are working without the benefit of our logic filter.[13] This can certainly make for some spectacular as well as disturbing dreams that wake us up as our subconscious looks for solutions.

The Circadian Rhythm is a label for physical, mental, and behavioral changes that follow a twenty-four-hour cycle. The rhythm we are interested in most, as it affects sleep, involves daylight and darkness.[14] Our brain senses the blue light spectrum our eyes see when we look at the sky. When night falls, our brain senses the absence of this spectrum and begins to produce melatonin which helps induce sleep. Yes, this is a term you are familiar with! Melatonin is available as an over-the-counter sleep aid available at pharmacies as well. Now, I realize at this moment we are talking about something physical going on in our bodies. Bear with me, I will get to the all-important non-physical point in a moment.

Our smart phone screens, tablet screens, and televisions also emit this same light spectrum. So, if you are staying up late watching television, gaming on your tablet, or texting your friends late into the night your brain isn't producing any melatonin. You won't fall asleep until you are literally exhausted, which is too late to get the full benefit of the eight hours of sleep every adult needs. Easy solution: turn your devices off one hour before bedtime. If you need additional help, read something; a magazine, book, your mail, anything that that does not require a digital device. You can also get screens for phones,

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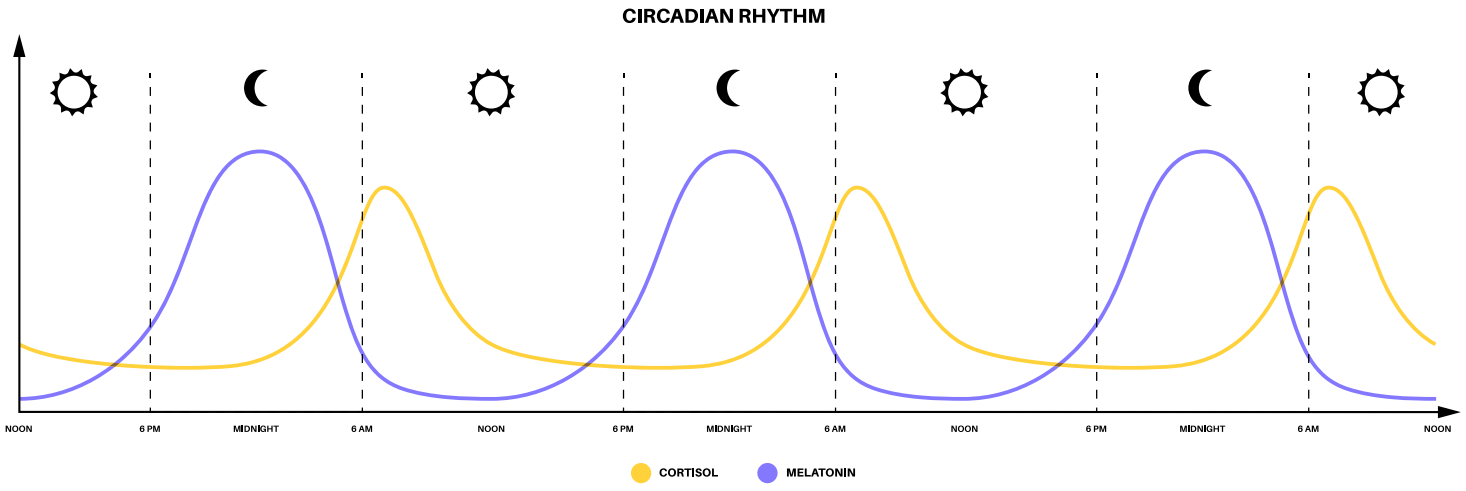
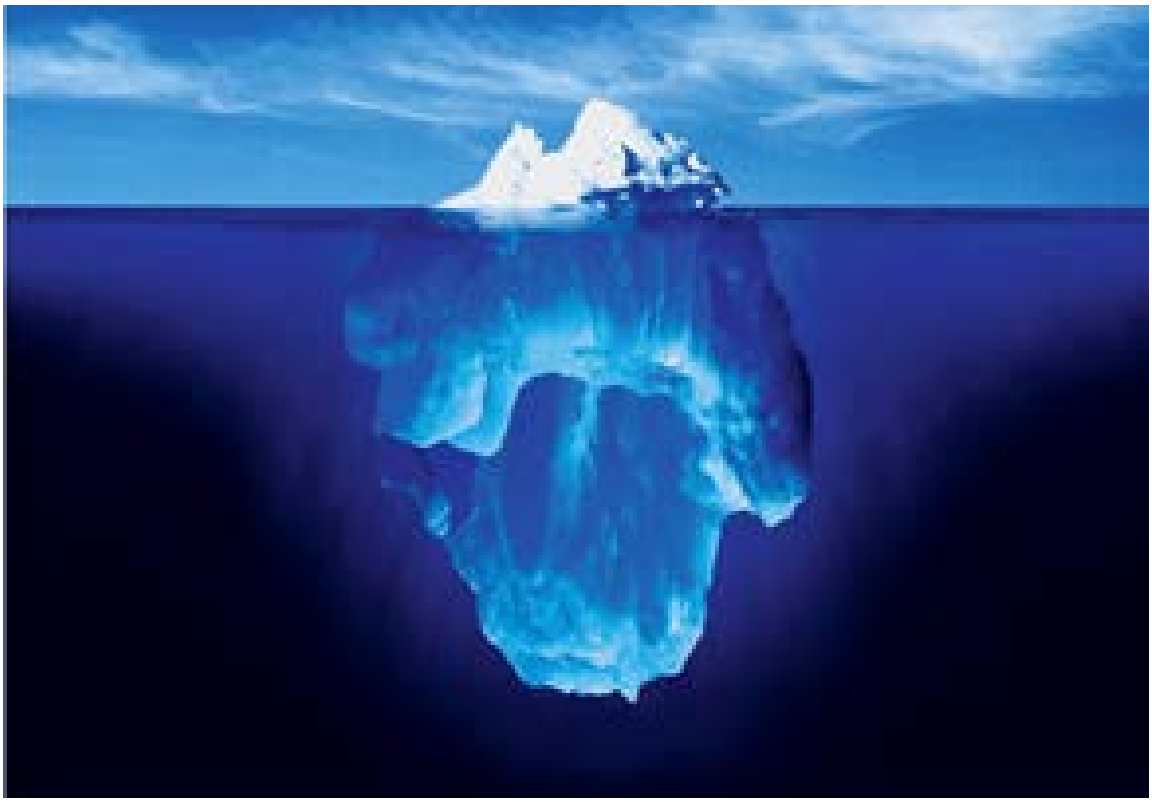


tablets and laptops that filter out this spectrum as well.

Here is the non-physical aspect of this problem. We cannot change the orbit of the earth and therefore the rising and setting of the sun. However, we can change our habits that are getting in the way of a good night's sleep. Otherwise, we must agree to accept the risk of disease inherent in lack of sleep.[15] Insufficient sleep has been linked to higher risk for developing Type 2 Diabetes. Sleep disturbance has been linked to higher risk for cardiovascular disease. Interrupted sleep has been linked to higher risk for obesity. The relationship between depression and sleep is complex with back-and-forth evidence of depression interrupting sleep and sleep interruptions worsening depression. I really like Winnie the Pooh's advice when it comes to sleep, "When all else fails, take a nap."[16] You can catch up on sleep you miss.

There are two very common but seldom recognized sources of sleep disturbance. These two conditions emerge into our consciousness ever so slowly and go unnoticed until they can no longer be ignored: moral distress and moral injury. When they do surface in our awareness most of us do not have a name for them and shunt them aside as bad feelings that should be ignored.



Moral distress occurs in an environment when one knows the right thing to do, but constraints make it nearly impossible to pursue the right course of action.

Moral distress is a psychological phenomenon quite different from ethical dilemmas or emotional distress.[17] Moral distress occurs in an environment when one knows the right thing to do, but constraints make it nearly impossible to pursue the right course of action.[18] This can occur in any situation where decisions, or indecision, are constrained by established requirements or overruled by others. The most common arena for this to occur is the workplace where institutional requirements are overruled by more senior leaders. This can also occur in relationships where social or cultural norms and values are violated by others, and no one does anything about it.

An example would be observing someone being verbally or physically abused and no one says or does anything about it out of fear of reprisals, avoidance (it is none of my business), embarrassment, or simply not knowing what to do. It leaves us with a moral dilemma we would rather avoid and forget. We move away from those kinds of incidents carrying the stress created with us. Enough of this can lead to moral injury.

A moral injury can occur in response to acting or witnessing behaviors that go against an individual's values and moral beliefs which erode self-esteem and confidence, breaking down long and strongly held beliefs about themselves and the world they live in. The result is disillusionment, despair, and eventual physiological and psychological burnout. It is like an iceberg which can sink anyone's boat and is not getting much attention.

Sources of moral distress and injury can vary widely. For example, care providers taking care of children or aging adults in their homes or institutions can develop compassion fatigue as a result of unending pressure to be engaged in caregiving without appropriate relief. We feel responsible, committed, and guilty or ashamed when it gets hard enough to quit. Our personal values and inability to hold up under pressure physically and emotionally are in constant conflict and we burnout. Or requirements to return to the office conflict with realities of living with a pandemic and your employer doesn't provide remote working options. Or, corners are cut, safety is ignored, and quality control is no longer enforced on the production line to the point you know if you speak up you will be out of a job. When we sleep our subconscious wrestles with these feelings enough to disturb our sleep, waking us up, often with feelings of guilt and shame we may not be able to attribute to anything specific.

If this is your experience, there is much hope! The first step is to recognize the situation for what it is and is not. It is an assault on your sense of right and wrong. It is not a judgment of who you are as a person. Consider what you can change and what you cannot change. You probably are not responsible for what you just experienced. You may need to think through or get some advice about what you should do if you encounter this experience again. Release what you

cannot control and respond to what you can control. You may need to reframe an issue to view it in a different way. Instead of thinking, "Well, I cannot do anything about that!" reconsider what you may be able to do, perhaps beginning with identifying who you can talk to that has good judgment about these kinds of dilemmas. Actively decide to be ready for what life puts in your way so that you know how to respond inwardly and what action, if any, to take walking away from a morally distressing experience.

The most significant preventative measure you can take to help ensure healthy sleep patterns is building and sustaining resilience. Resilience is a cumulative result of several elements working together. Leave something out, and you will not get the desired result. These are not new factors: good nutrition, sufficient exercise, and sleeping at least eight hours a day. Add to that meaningful relationships and purposeful work and you will minimize the impact of any moral distress you may experience. When the obvious has been considered and discarded, discovering why you are not sleeping well can be very confusing. It is like my life coach, Winnie the Pooh, says, "I am not lost, for I know where I am. But however, where I am may be lost."[19] Look at the big picture: physical health, mental wellness, good friends, and work that is important to you and you may just come up with a new revelation about where you really are and know what to do.

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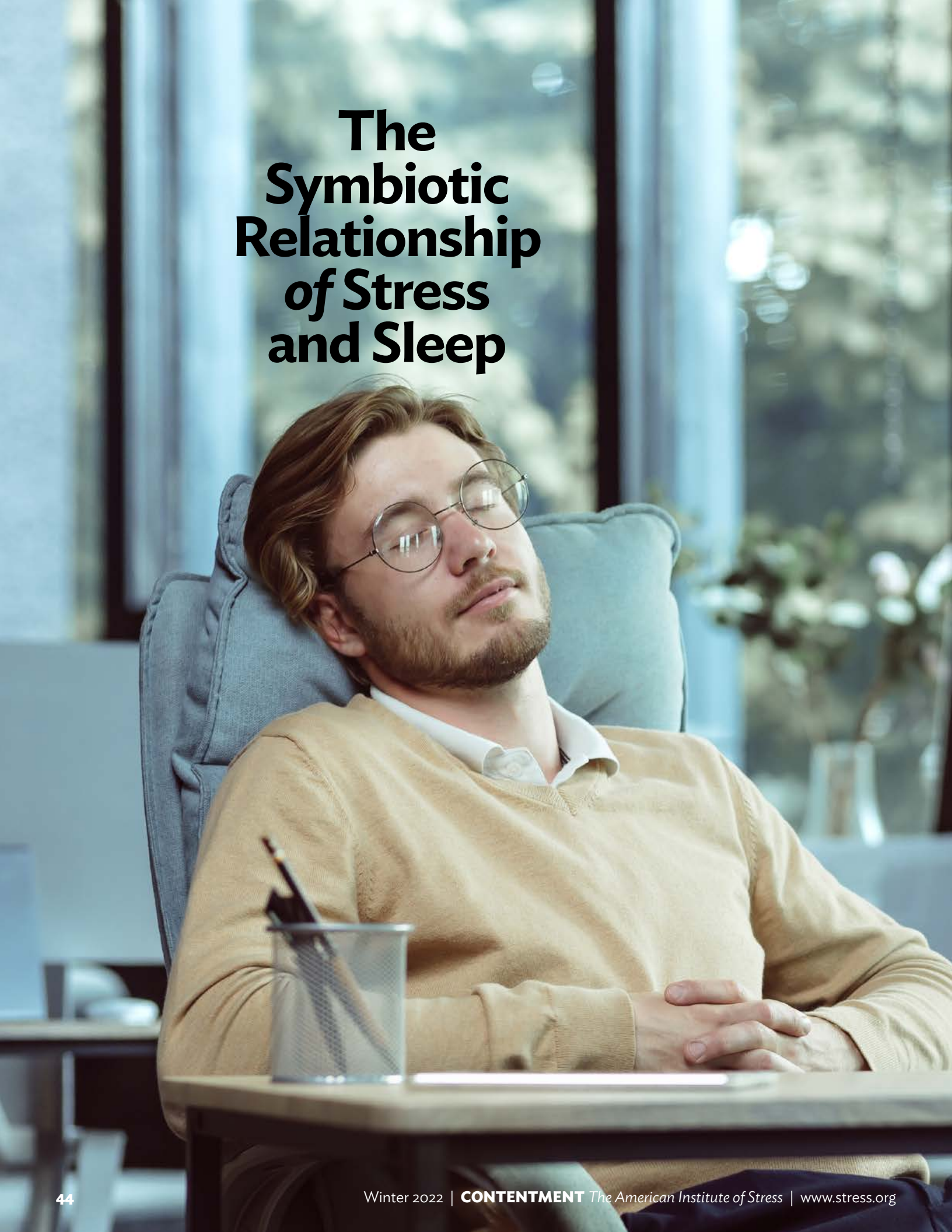
The Symbiotic Relationship *of* Stress and Sleep



By Evian Gordon MD, PhD, FAIS
Founder and Chief Medical Officer
Total Brain
and Jennifer Franklin
Founder of Totally Immune.com

Guess what? If you're stressed, you're going to have trouble sleeping. And you know what else? It can become a vicious cycle that will cause MORE stress and LESS sleep. But you already knew that, so let's get into breaking that cycle and getting some darn sleep already, which, of course, will decrease your stress and enhance your well-being.

Most adults need 7-9 hours of sleep a night. There are a growing number of studies that highlight the health impact and risk of a range of diseases (from cardiac problems to depression and stroke), from less than 7 hours of sleep a night. What is a particularly telling pointer to the hazards of a cumulative chronic sleep deficit, is that even 1 night of fewer than 6 hours of sleep, has significant stress, attention, negativity, and decision-making effects the following day.[1]

Most of us want better sleep. But, where to start? It's not only what you do before bed, but also what you do ALL day that matters.

In this article, we will cover sleep issues that are not medical, such as insomnia, which is trouble falling asleep and staying asleep. Medical sleep disorders, such as sleep apnea (paused breathing and heavy snoring due to periods of the blocked airway), need to be diagnosed and treated by a sleep specialist.

You are designed to sleep.

Your body has a 24-hour repeating sleep-wake cycle called the Circadian Rhythm.[2] Simply put, it is your mental, physical, and behavioral changes

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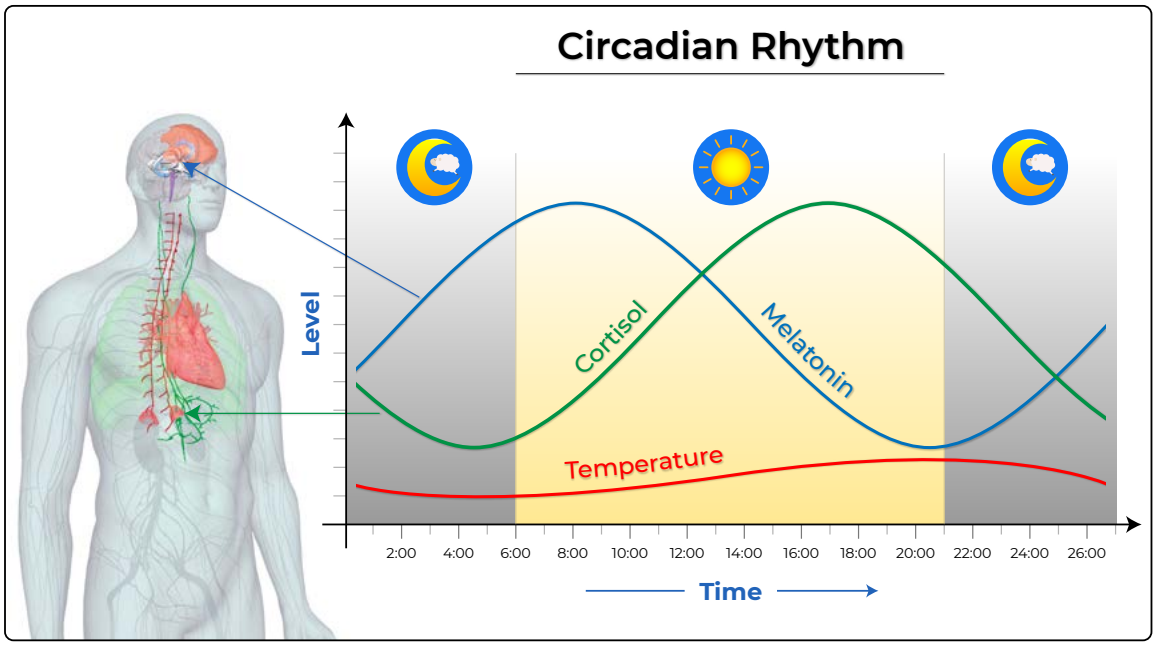

Figure 1: Findings from the Total Brain International Database. Our team found deficits in Stress and Attention as well as enhanced Negativity, associated with even 1 night of poor sleep of fewer than 6 hours.1

across 24 hours. The environmental cycle of light and dark helps to determine your sleepiness and wakefulness. As you go about your 24-hour cycle, your body is going through many biological processes affected by the light and dark cycle.

The three most known circadian rhythms are melatonin, cortisol, and temperature. Melatonin is the primary sleep hormone that is part of the "switch" that begins your sleep cycle. Once your sleep cycle is switched on, it has a regular hard-wired cadence through the five stages of sleep (which can be disrupted by stress and other issues). A slight drop in temperature also aids at the beginning of sleep. Raised cortisol, the primary stress hormone, can be one of the factors that keep you awake, but in the morning, it helps you to wake up.

Figure 2 shows the changes in these dynamics that form an integral part of your "daily clock". This marvelous adaptive homeostatic orchestration is readily disrupted by stress.

Your Circadian Rhythm can be affected by:

- Poor sleep habits – we will get into that in a moment.
- Body temperature – not too hot, not too cold, thank you.
- Eating habits – eating too much or too late, as well as alcohol and caffeine.
- Stress – you knew that was coming.

The best place to start are your pre-sleep habits. Handling sleep habits can clear up a lot of general sleep issues, such as insomnia and stress-related sleep issues. There is a lot of in-depth sleep hygiene "should-do list" info out there. Much of it comes down to routine and personalization. In this article, we will cover the framework for creating a successful sleep environment. For a more comprehensive journey or sleep reset, a sleep course or coach can further help get you back on track.

The goal of quality sleep habits is to make an ally out of your circadian rhythm. Working with nature and your hormones is ground zero and the first step to natural restorative sleep. To get to sleep, you want to increase your melatonin and decrease your stress-related cortisol, so your body gets the message that it's time to sleep and then time to wake up.

Here are some of the ways to create conducive sleep habits:

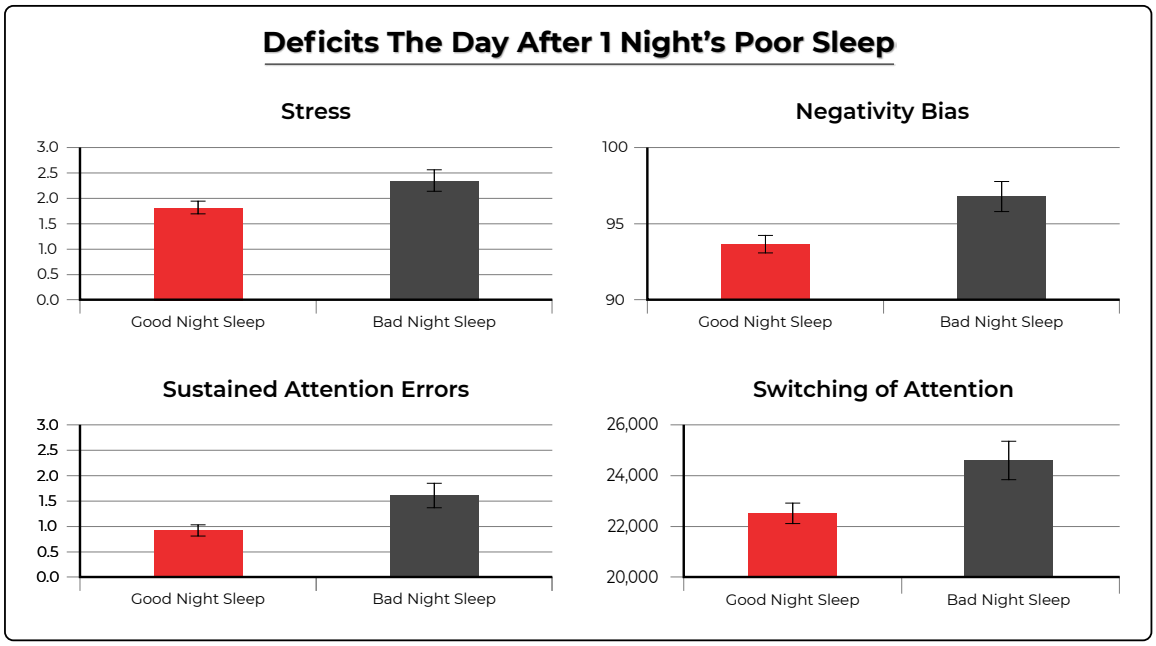

Figure 2: Three key processes in the 24-hour ongoing circadian rhythm that reflect our daily interconnection to light and dark. Increased melatonin and reduced temperature are part of the OFF switch to sleep. Increased cortisol is a part of the ON switch to awaken. These processes are readily disrupted by stress.

Prepare your sleep environment. Your brain loves a routine. Safety is your brain's first and foremost priority. Routines are safe expected outcomes that your brain and body can rely on, which decreases stress. Create a winding down time about an hour before you want to sleep.

5 Ways to Build Successful Sleep Habits

1. ***Consistency.*** Go to bed and wake up at approximately the same time every night and day. Brain. Safety. Routine. Check.
2. ***Put down the devices.*** (OH NO, not the devices!) TV, phones, tablets, and computers all emit a strong blue light that suppresses melatonin, the hormone critical to sleep. But reading is back in style and a relaxing way to prepare for sleep. Just not Stephen King! We love Stephen King, but it can be too stimulating before bed.
3. ***Warm shower or bath.*** It feels nice and there's evidence its helpful.[3] As you sleep your core body temperature drops. By taking a warm bath or shower about an hour before bed, your body will heat up and then cool down signaling to your brain it's time to sleep.
4. ***Clear your mind of perseverative negative thoughts*** before bedtime by writing things down, making a to-do list earlier in the evening, and doing what works for you in reframing the problem into a potential solution. This is helpful if you tend to worry and think too much in bed at night.
5. ***Create a dedicated sleep room.*** Dim the lights. Light stimulates your wake-up hormones (cortisol) and suppresses sleep hormones (melatonin). Temperature control also signals sleep time, remember the warm shower? A cool room (60-71 Fahrenheit) is conducive to sleep. Get comfortable. Are your pillows comfortable and supportive? How's your mattress? Think of Goldilocks, not too soft, not too firm. Do you wake up at night with clothes tangled around you? Some people find weighted blankets to be soothing and relaxing. Small changes in routine and comfort can make a big difference.

Fun fact: Your brain never stops being active. But it does need your body to sleep so it can do what it needs to do. Lack of quality sleep affects your brain as well as physical exhaustion. Memory and new associations (knowledge) are consolidated during your sleep cycle. Sleep deprivation can affect learning, reaction time (accidents), metabolic rate (weight gain), and your immune system.

Healthy Sleep Habits: How your brain can help you sleep

Now that covers the before-bed issues. But what if you are dialed in on your sleep hygiene and you are still suffering? The next step is to determine what's going on in your daily life that can be adjusted to facilitate restorative sleep.

As stated earlier, it's not just what you do before bed, it's what you do ALL day that matters. It's a 24-hour sleep-wake cycle. If your sleep issues are compounded by your daily life stress, there are steps to ease that stress and begin to tip the scales toward getting proper sleep which will, in turn, provide you with the power to get through those stressful days.

You want the stress-sleep symbiotic relationship to be on the positive side. Win-win.

Here are **5 steps to manage your daily life stress,** which will pay off when you head to bed.

1. ***Befriend Routine.*** As much as you can, automate your days, just like your pre-sleep evening routine. The less left up to winging it, the better. Even if your days are not routine-able, creating a schedule can eliminate stress caused by uncertainty. This in no way precludes spontaneity, but it simply provides a regular framework. Having a plan bolsters your brain's need for safety through expected outcomes.[4]
2. ***Proactive Stress Plan.*** Often insomnia is stress related. A well-researched and fast way to switch off your stress system is breathing at 6 breaths per minute (Resonant Breathing), to activate your relaxation response.[5] There are many wonderful digital tools to help induce a calm-flexible state prior to sleep, including Neurotunes music for sleep (in TotalBrain.com) and Alpha-Stim.
3. ***Nature.*** Just like our attunement to light-dark, our biological nature can be a part of belonging and meaning to the brain and body through experiencing nature. Make going outside a priority. If you have to multi-task, do it. See the sun first thing in the morning to reset your melatonin clock to its natural state. Make phone calls outside, eat a meal outside. If you have kids or pets, get outside with them. If you're not a morning person, make the effort to get outside in the morning to stimulate cortisol and take advantage of the light to get you going.
4. ***Move.*** Yes, we know, exercise is the answer to so many problems. But we said move. Just like getting out in nature is a natural human need to thrive, there can't be enough said about challenging the sedentary lifestyle. If you're a desk jockey, incorporating hourly movement (even a few minutes) will make a huge impact on nearly every aspect of your health. The human body is meant to move. By capitalizing on getting more movement during the day, your body will have a greater likelihood to be ready for sleep recovery at the end of your day. Moving your body is a cornerstone to managing both stress and sleep.[6]
5. ***Food.*** Food is going to either help or hinder sleep. What you eat and drink matters for natural sleep. Alcohol may appear to help you sleep, but the quality is diminished, and the needed brain and body recovery is compromised. Although it may seem obvious, caffeine close to bedtime is not your friend either for good sleep. Even if you can sleep after a cup of coffee, it is like alcohol in that it negatively impacts restorative sleep. Without getting into the perfect diet, how to approach food in relation to sleep is to find your sweet spot between feeling satiated, and not too full. Not long ago, many cultures ate their largest meal at lunch. Before the dawn of office work and computer jobs, eating a big midday meal got most people through the physical demands of life. Now we've pushed the big

meal to the end of the day to be more productive. That has contributed to sleep issues for many people. Digestion is a high-energy function for your body and can disrupt sleep patterns.[6]

A lifestyle program that addresses the 4 pillars of health — Calm, Move, Eat and Connect — can get you on your way to enhancing restorative sleep.[6]

Remember: The biggest gap is between Knowing and Doing! Years of tracking the neuroscience of habit generation have shown that small steps, readiness to change, and a 30-day challenge, increase the likelihood of success.[4]

Habits are simply neural networks that are wired in your brain. Sleep habits are like any other habit you currently have or would like to have. It takes a PLAN, a focus on what you WILL do rather than SHOULD do, and small step-by-step consistency to wire new brain habits that stick.

By now you have surmised your brain, body, and lifestyle are all interconnected. Sleep issues are often a symptom of stress, overstimulation, health choices, and a sedentary lifestyle. You *can* improve your sleep. Small adjustments or a combination of personalized tools and habits can get you on your way to restorative natural sleep. Let's flip this symbiotic relationship of stress and sleep to the supportive positive side and compound the benefits.

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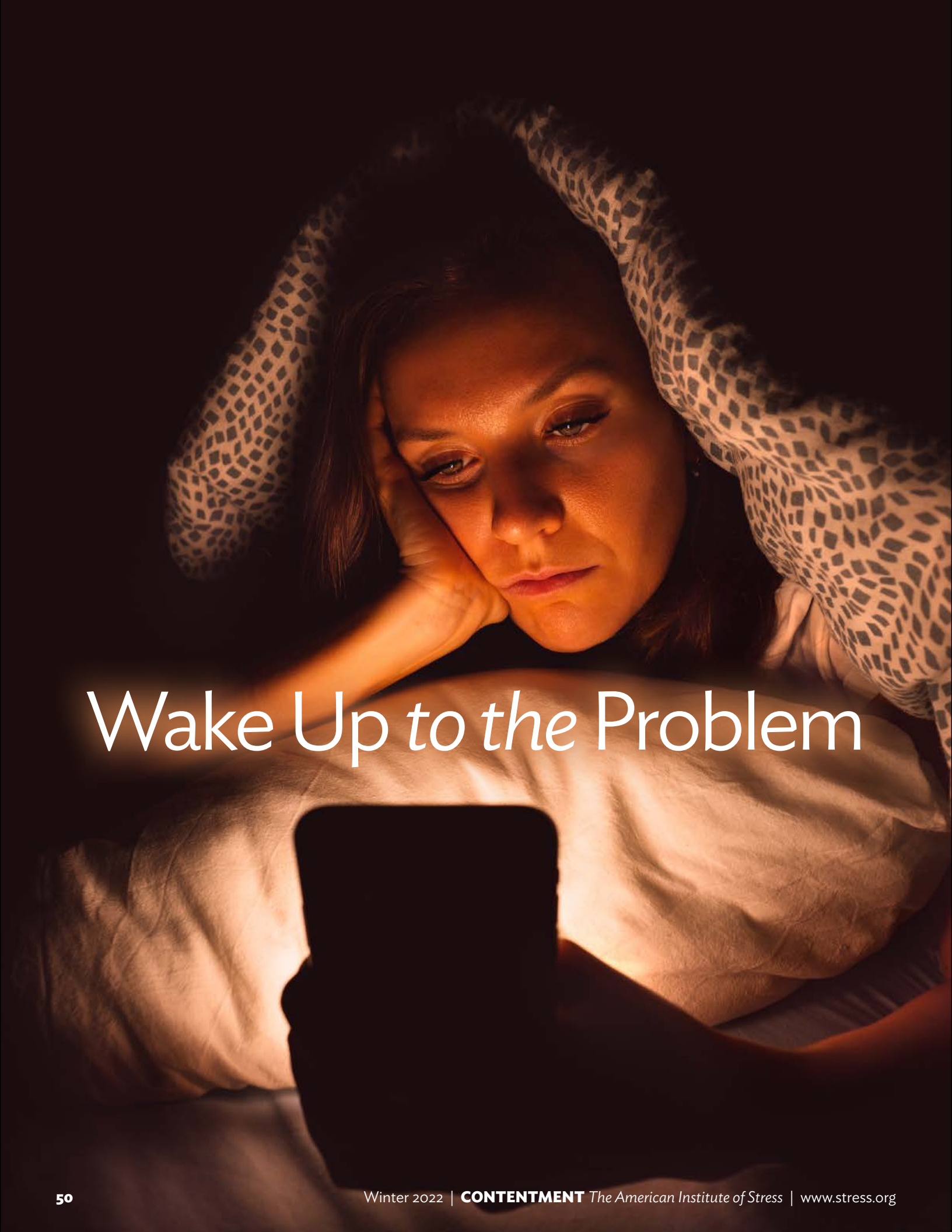
**Both authors contributed to the development of the ThinkHeart online "Lifestyle Medicine" course with The American Heart Association (AHA) to enhance Calm, Move, Eat and Connect. https://thinkheart.totalbrain.com/*



Wake Up *to the* Problem

By Rita Hitching BSc, MSc, PhD Candidate
Christopher Gordon BN, PhD
Lisa Lampe MBBS, PhD, FRANZCP

In 1789, one of our most influential Founding Fathers — Benjamin Franklin (1706-1790) — famously wrote, "...In this world, nothing is certain except death and taxes." I would argue that if Franklin were alive today, he would probably have said "... In this world, nothing is certain except death, taxes, and stress..."

In this article, we demonstrate the relationship between stress and sleep disturbance and explore how technology, previously criticized as being the trigger for our high-stress living, is being used for good. We also highlight how the emerging application of Virtual Reality is helping ensure you get a good night's sleep by facilitating the delivery of existing treatments such as mindfulness.

How Does Stress Impact Health?

Statistics from the CDC show that even before the stress associated with the pandemic, more than 60 million Americans reported chronic sleep difficulties.[1] Since then, rising inflation and living costs, and global uncertainty, including the invasion of Ukraine, have escalated stress levels even further. A 2021 Stress in America survey by the American Psychological Association reports that regardless of age, background, or walk of life every American is suffering.[2] Persistent stressors such as difficulties at work, family or relationship problems, and financial worries are known risk factors for disease and premature death.[3] One of the lesser-known ways chronic stress impacts physical and mental health is through the disruption of our body's principal restorative tool – sleep.

What can be described as stress varies enormously, but from a physiological perspective the cocktail of chemicals your body mixes in response to it is the same. Any stimulus or stressor — physical or psychological — if potentially harmful or even just challenging will elicit a stress response. The stress system begins with the activation of two discrete physiological mechanisms: the sympathetic-adreno-medullary (SAM) axis releasing adrenaline (epinephrine) and noradrenaline (norepinephrine) and the hypothalamic–pituitary–adrenal (HPA) axis releasing glucocorticoids such as cortisol. The elevated cortisol levels that are part of the fight or flight stress response promote alertness and inhibit sleep. What this coordinated response accomplishes is a readiness for fight or flight by promoting metabolic changes and mobilizing energy sources with notable increases in heart and breathing rates and glucose release.

To maximize a prompt and concerted response to overcome the perceived challenge the body also suppresses the digestive, reproductive, and immune systems. If you have ever wondered why being stressed makes you more likely to catch a cold, get an upset tummy, or make you lose interest in your nearest and

One of the lesser-known ways chronic stress impacts physical and mental health is through the disruption of our body's principal restorative tool – sleep.

dearest — now you know why! The body's brilliant lifesaving stress response places a lot of physiological demands, often before, during, and after a stressful situation. If you just responded to an emergency or finished a big presentation — once the immediate 'danger' is out of the way — you feel ready to collapse into a heap. You might even feel like you need to lie down or take a nap!

Is Stress the Cause of Disrupted Sleep?

Exactly how stress impairs our ability to sleep remains unclear, but stressful life events have long been known to trigger sleep disorders, most commonly insomnia. One thing we do know is that our body's response to stress shares the same brain pathways with those that govern our sleep-wake cycle – the HPA axis.

The acute or short-term stressors associated with day-to-day life may prevent you from getting a good night's sleep every now and then, but do not typically result in persistent sleep difficulties. In contrast, the persistently high cortisol levels attributed to the relentless activation of the stress response by ongoing or chronic stressors contribute to the dysregulation of the HPA axis by reducing its sensitivity to cortisol and inhibiting the release of melatonin associated with sleep onset. Chronic stress also appears to change the very architecture of sleep. When you are stressed, you spend less time in the restorative zone of sleep known as slow wave and rapid eye movement (REM) sleep. The impact of stress on sleep goes even further, influencing the emotional content and patterns of dreaming.

Disrupted sleep impairs memory and attention, learning and problem-solving abilities, and increases the risk of accidents and injuries, particularly motor vehicle accidents.

Why Does Sleep Matter?

Like stress, insomnia is highly prevalent and associated with significant economic and healthcare burden, morbidity, and mortality. Insufficient sleep costs the US economy $411 billion each year in lost productivity (reduced employment, premature death, absenteeism, and presenteeism).[4] The pervasive nature of sleep disorders, in particular, insomnia has been referred to as a 'global epidemic' by the World Health Organization.[5]

Sleep is critical to health and wellbeing because it enables our bodies and importantly, our brains to rest, repair, and rejuvenate. The strength of the relationship between chronic stress and sleep disturbance is underscored by the strong associations they share with common health conditions such as type II diabetes and obesity, cardiovascular

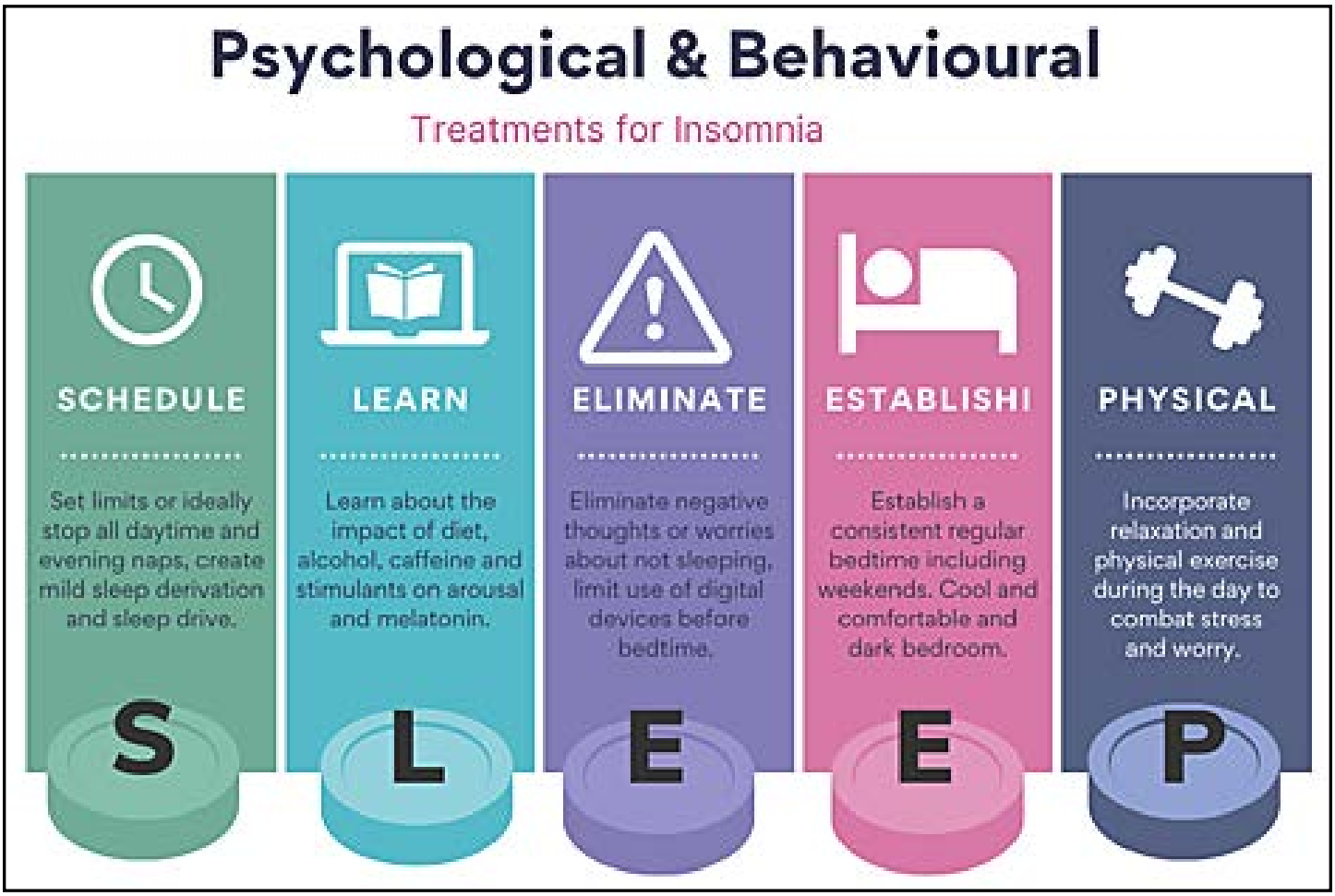


Figure 1: Behavioural & Cognitive Modifications to Support Insomnia

disease and hypertension, Parkinson's and Alzheimer's diseases, stroke, and chronic pain. Disrupted sleep impairs memory and attention, learning and problem-solving abilities, and increases the risk of accidents and injuries, particularly motor vehicle accidents. Quality of life is reduced when sleep difficulties persist. In addition, insomnia or poor sleep is known to increase the risk of psychiatric disorders such as depression and anxiety and may contribute to relapse and impede recovery. Insomnia is a strong risk factor for suicide and a more powerful predictor than depression.[6,7]

What Treatments Are Available?

Growing public concern about the health impact of poor sleep has resulted in increased demand for effective strategies to help us get a good night's sleep. Considering the relationship between stress and disrupted sleep, approaches that minimize the impact of chronic stress like regular exercise (preferably outdoors), low fat/sugar diets, and the avoidance of caffeine, nicotine, and alcohol are central to addressing sleep difficulties.

First-line approaches include behavioural modifications such as sleep hygiene and limiting daytime naps to support the sleep-wake cycle in concert with cognitive therapies that target the thoughts that often contribute to sleep problems. (See Figure 1). In addition to adopting strategies that counteract the effects of stress in our life, including our sleep, finding ways to gain greater control over our actions and their consequences means even highly stressful situations like

a chronic illness or relationship problems become more manageable.

Can Technologies Like VR Be Used to Facilitate Sleep?

As our understanding that even small lifestyle changes can have powerful short and long-term impacts on our health has grown, so has the demand for tools[8] to help us track our daily activities and facilitate behavioural change.[9,10] Available tools have been greatly aided by advances in modern technology that facilitate human-computer interactions (HCI), the same modern technology that at times has been considered a catalyst for stress and a contributor to poor sleep – the smartphone and social media.

VR has already been shown to reduce physiological, psychological, and biochemical stress indicators known to contribute to insomnia.

HCI tools to help you take control of your wellbeing are being incorporated into a burgeoning array of hardware and software options[11] including smartwatches that track your sleep, bed pads and pillows that keep you cool, glasses to block blue light, yellow light bulbs to stimulate melatonin secretion, sunrise alarm clocks, weighted blankets, noise-cancelling earbuds that also transmit nature sounds, wrist bands that measure stress levels and remind you to "calm down and relax", headbands to support deep sleep, and meditation and mindfulness apps to help manage stress, reduce anxiety, and promote sleep.

Some of these tools and devices are adding other HCI interfaces like Virtual Reality (VR), typically associated with the entertainment and gaming industry to enhance their therapeutic offering[12]. The new generation of VR is accessible via inexpensive, lightweight, easy to use, and highly portable smartphones, that use low-cost optics, and pre-warp images to deliver high-quality crisp graphics that are remarkably immersive and can be viewed using VR helmets without the need for hardwiring to fast and expensive gaming computers. The immersive three-dimensional world of VR creates a feeling of being in a new world or reality, rather than viewing it on a screen. Users can interact with the virtual world enabling experiences like to feel more realistic.

The neurobehavioral mechanisms of action of digital technologies like VR are still unclear, but VR is associated with changes to cortical activity principally in the anterior cingulate cortex and the orbitofrontal region of the brain. How the process occurs is largely unknown, but thought to be attributed to stimulation of the visual cortex through the pathways of the optic nerve during immersion.[12]

VR[13] has been used to augment the delivery of existing treatments such as exposure therapy (ET) and cognitive behavioural therapy (CBT) for disorders that frequently show vulnerability to chronic stress such as PTSD, social anxiety, OCD, depression, and ADHD.[14] VR is also being used to offer real-time biofeedback in conjunction with other behavioural approaches to target psychiatric disorders that frequently include insomnia as a presenting symptom.[15] The overlapping nature of chronic stress, psychiatric symptoms, and sleep should not come as a surprise when you consider that the neural pathways that regulate stress also regulate sleep, and regulate mood and anxiety.[16]

The success of VR at targeting disorders commonly associated with poor sleep is paving the way for research exploring its potential for the treatment of insomnia. Critical to being able to fall asleep is the ability to feel relaxed and calm. VR has already been shown to reduce physiological, psychological, and biochemical stress indicators known to contribute to insomnia.[17] Consequently,

a promising application of VR is targeting hyperarousal[18] (elevated heart rate and blood pressure, cortical activity,[19, 20] and anxiety) common in insomnia. [21, 22]

Leveraging VR's capacity to capture focused attention by excluding and immersing the user in a calm and peaceful virtual world, may augment the proven benefits of traditional relaxation techniques that are central to evidence-based treatments for insomnia like CBT.[22] VR therapies are expected to result in greater modulation of arousal levels to facilitate sleep onset more effectively than traditional relaxation techniques.[23]

The use of VR relaxation before sleep has led to sustained reductions in hyper-arousal and self-reported levels of worry[24] – known to contribute to insomnia.[25] In addition to amplifying the benefits of relaxation, VR has been shown to improve sleep quality[26] by reducing the number of

awakenings and sleep stage transition.[22, 26] In addition, the use of a virtual lullaby machine that combines a mix of ambient music with dynamic kaleidoscopic visuals has been shown to reduce cognitive arousal or drown out thoughts and induce sleepiness.[27] If this idea of a virtual lullaby sounds appealing, similar commercially available options can be found in the App store.

Although the application of VR for sleep is still in its early stages and more research is needed, the preliminary findings are showing promise. VR offers the potential for engaging personalized environments that can provide real and lasting therapeutic benefits. It just might be time to buy a VR headset.

VR offers the potential for engaging personalized environments that can provide real and lasting therapeutic benefits.

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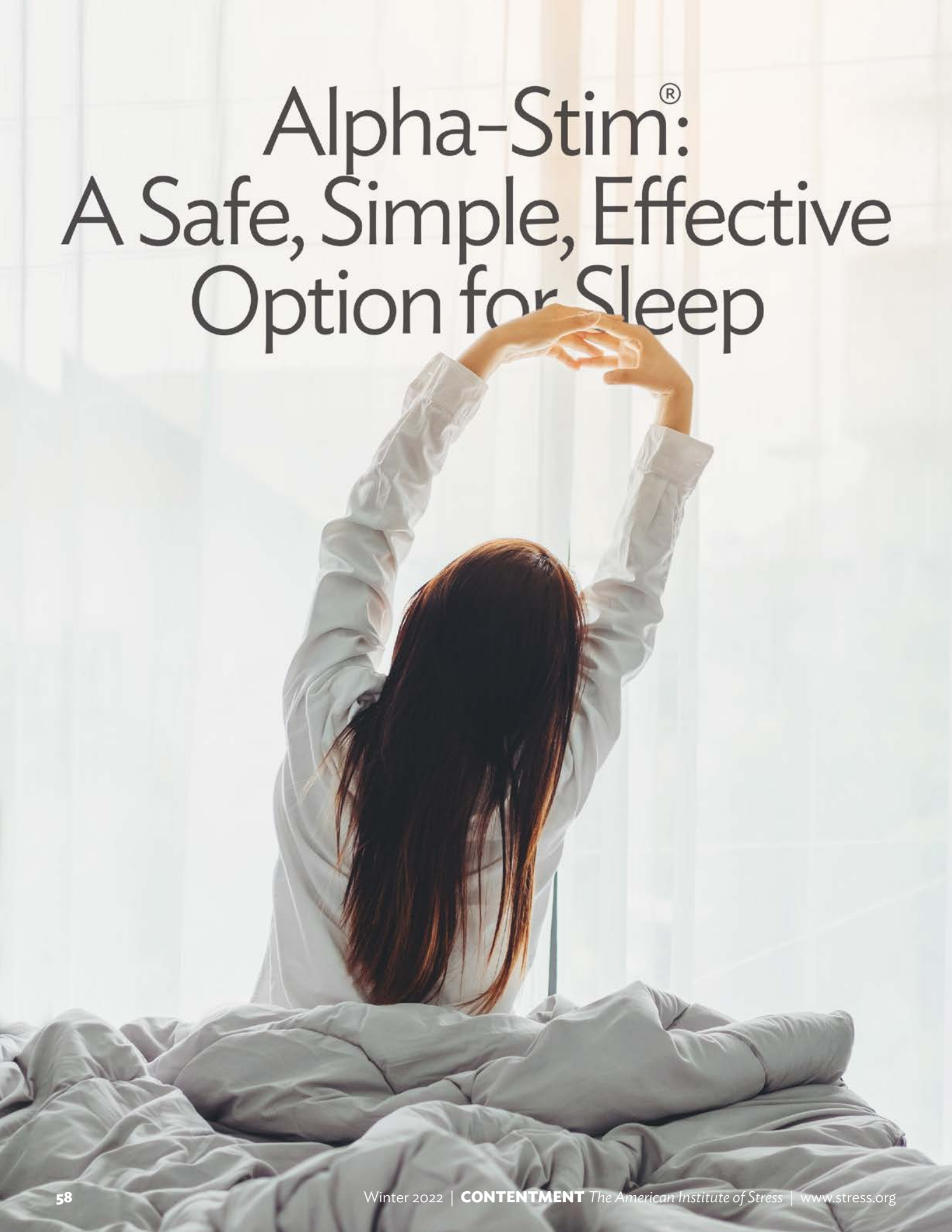
Associate Lecturer at the University of Newcastle School of Medicine and Public Health, **Rita Hitching** *is completing her PhD exploring how virtual reality may be used to deliver insomnia treatment to modulate the bidirectional relationship between disordered sleep, brain function, and psychiatric disorders. She is a well-respected writer and the editor of Briefing Books at the Association for Behavioural & Cognitive Therapies.*

Alpha-Stim®: A Safe, Simple, Effective Option for Sleep



By Josh Briley, PhD, BCMAS, FAIS

Do you struggle with getting enough sleep? You are not alone. Chronic sleep problems are becoming more prevalent. A recent survey[1] found that 61% of young adults, and half of adults over the age of 50, reported difficulty falling and/or staying asleep the previous night. Not surprisingly, stress has been found to have a negative impact on quality of sleep, as almost twice as many respondents who reported high levels of stress reported difficulty sleeping. With a recent Gallup poll showing people worldwide are feeling more stressed than ever,[2] it is no surprise that sleep difficulties are also becoming more prevalent.

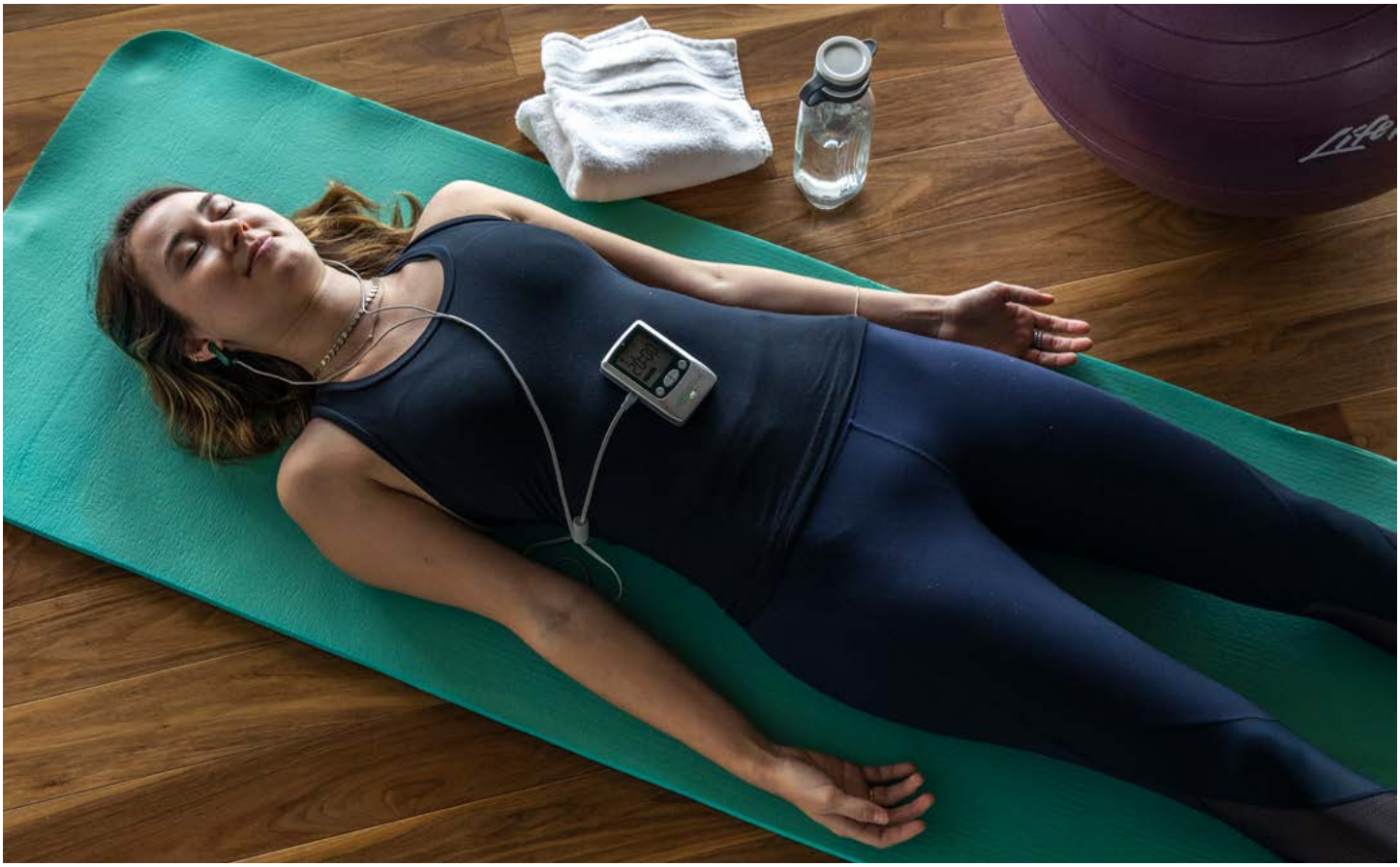
Many people turn to either medications or supplements, such as melatonin, to help them sleep. However, these sleep aids often come with their own difficulties. Sleep medications, and sometimes even melatonin, can contribute to drowsiness the next day or difficulty waking in the night if needed. As a clinical psychologist, I have worked with patients who, when prescribed sleep medications for prolonged periods, begin to act out their dreams and have awakened in their kitchens, their living rooms, or even in their vehicles (fortunately still in the driveway).

Additionally, sleep difficulties are often exacerbated by, and themselves exacerbate, other medical and mental health issues, such as anxiety, depression, or chronic pain. Sleep disturbances may also be a side effect of medications used to treat these conditions. Simply taking a medication or supplement to try and improve sleep does not address the underlying issue that may be contributing to your sleep difficulties, and thus may lose effectiveness over time.

The good news is there is an alternative that works quickly, safely, and effectively. Alpha-Stim® is a portable device designed to be used at home that is FDA cleared for the treatment of insomnia, anxiety, depression, and pain. Alpha-Stim Cranial Electrotherapy Stimulation (CES) is the only device available at this time that utilizes a patented waveform to transmit a variety of electrical frequencies into the central nervous system. These frequencies help to calm cells that are hyperactive, while simultaneously stimulating activity in cells that are underactive. The electrical current is transmitted across the brain via the use of earclip electrodes that clip onto the earlobes. In the United States, purchase of an Alpha-Stim requires an order from a health care provider that is licensed to diagnose and treat anxiety, insomnia, depression, and/or pain. However, in other countries, Alpha-Stim can be purchased over the counter. Side effects are extremely rare, occurring less than 1% of the time, mild, and self-limiting.

Unlike medications or supplements, Alpha-Stim does not make you drowsy in the moment nor does it contribute to residual drowsiness the next day. In fact, while Alpha-Stim does create a sense of relaxation and calmness, many people also

A recent survey found that 61% of young adults, and half of adults over the age of 50, reported difficulty falling and/or staying asleep the previous night.



report feeling very alert and focused upon completing an Alpha-Stim treatment. Therefore, it is recommended that people use Alpha-Stim no less than three hours before bedtime to prevent this alertness from further interfering with the ability to fall asleep. In contrast, there are many people who are able to fall asleep during or immediately following an Alpha-Stim treatment, and such people are able to use Alpha-Stim just before bedtime. As mentioned above, Alpha-Stim works to balance the nervous system and restore homeostasis. Proper sleep patterns are part of an optimally functioning nervous system. In contrast to medications and other insomnia treatments, you do not develop a tolerance or become addicted to Alpha-Stim. Quite the contrary, the effects are cumulative, so the more consecutive days you use Alpha-Stim to treat your insomnia, the better the results will be and the longer they will last.

Case Examples

I used Alpha-Stim in my work as a psychologist for the Veterans Health Administration. I have also conducted countless demonstrations with Alpha-Stim as the Clinical Education Director for EPI, the manufacturer and distributor of the device. The results I have seen are nothing short of remarkable. Many of the Veterans that saw me had difficulty falling and/or staying asleep every night. Most of them were on medications that were supposed to help them sleep but did not. After a few days of using an Alpha-Stim, most of these Veterans were falling asleep quickly and staying asleep throughout the night.

I once had a coworker who had chronic and severe insomnia. She had not slept more than four or five hours a night, usually less, over the past few decades. One afternoon she used an Alpha-Stim at work. When she went home that evening,

she followed her normal routine, only she fell asleep as soon as she went to bed and woke up over 14 hours later to the phone ringing because she was over three hours late for work. She reported sleeping better than she had in years and stated, "it looked like someone made the bed with me in it." She did not use the Alpha-Stim that day, and still slept approximately 12 hours the next night.

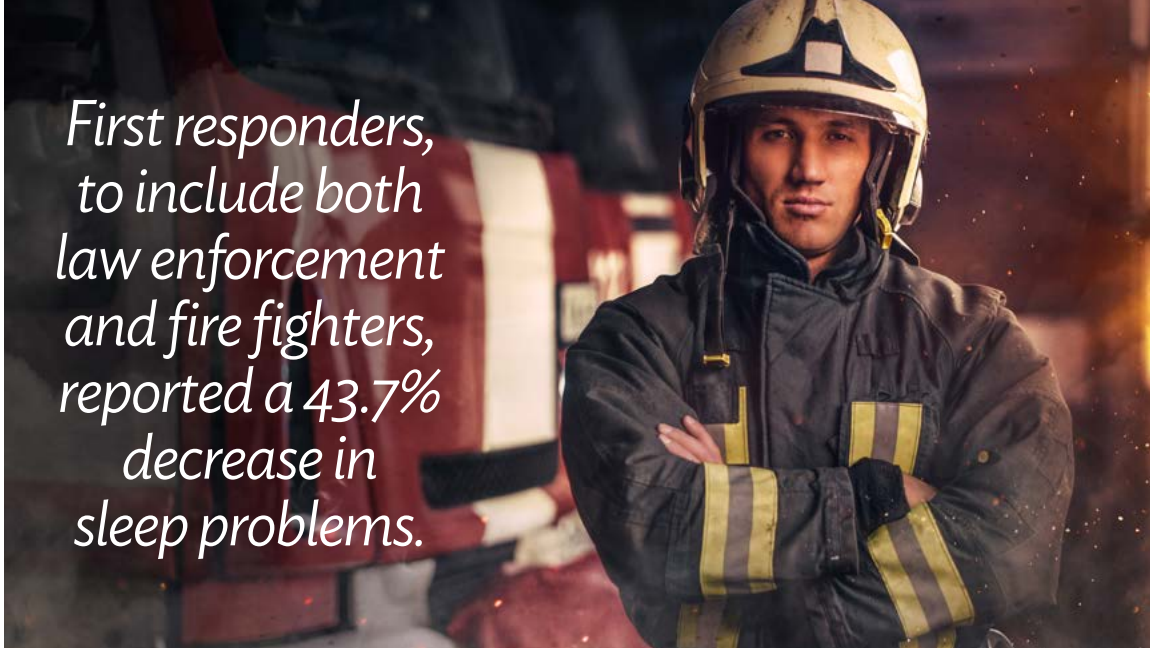
In May 2022, I was working at a conference, and an exhibitor across the hall from our booth completed a demo with an Alpha-Stim, again about mid-afternoon. The next morning, she showed up later than she had been arriving to the booth the previous days. She came over and stated she had slept through her alarm and was running late. A few hours later, she came back over to the booth and said her FitBit was reporting she had the best night sleep in over a month.

At a conference in Baltimore in October 2022, a health care provider completed an Alpha-Stim demo at our exhibit booth. I saw her two days later, and she reported she was sleepi8ng better than usual, especially for being in a hotel room, and still felt very relaxed and alert.

My favorite example of how well Alpha-Stim can improve sleep comes from a four-time cancer survivor I spoke with recently. She obtained an Alpha-Stim from Roswell Park Cancer Center in Buffalo, NY. When I spoke with her, she stated she had used her Alpha-Stim every day for just over a week, and for the past two nights, she had slept through the night for the first time in 22 years. She was very grateful that she was finally able to sleep well.

Clinical Evidence

Alpha-Stim can work quickly to improve your sleep quality and quantity, as the



testimonials above demonstrate. Scientific research conducted with Alpha-Stim also demonstrates the effectiveness and cumulative nature in improving sleep in a variety of patient populations, as summarized in recently published systematic reviews.[3,4] Additionally, a study conducted at Walter Reed[5] found that with only five nights' use, patients using Alpha-Stim reported an average of 43 more minutes of sleep, whereas patients using a sham device reported almost 20 minutes' less sleep (See Figure 1).

Figure 1 Total change in sleep time in active-duty service members in five nights.
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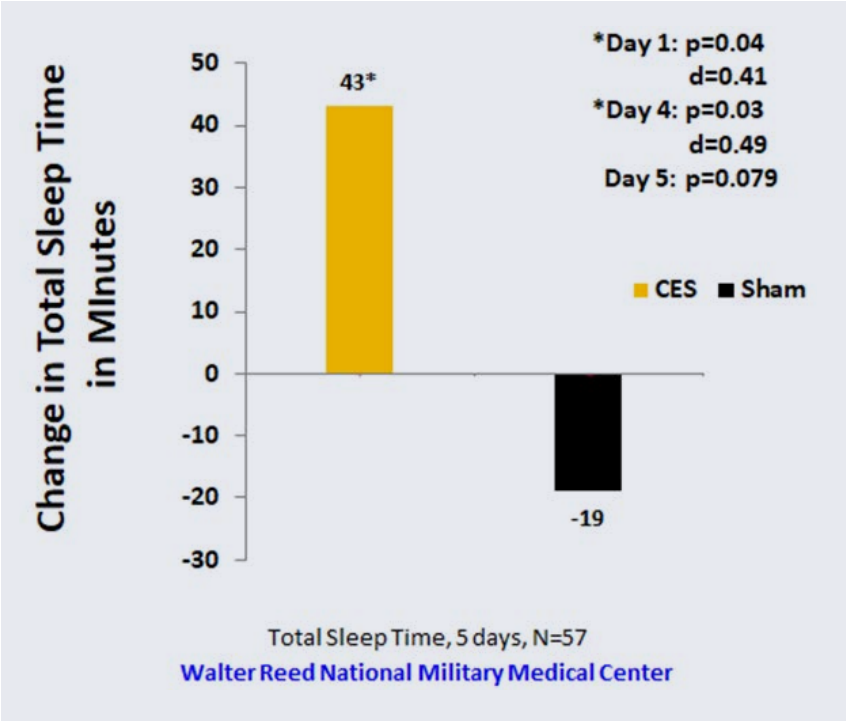

Furthermore, the results seen with Alpha-Stim are cumulative, with results getting better and lasting longer with continued use. A recent study conducted in the UK[6] showed that not only did patients' sleep improve during 12 weeks of Alpha-Stim treatment, but that improvement continued during the subsequent 12 weeks after treatment had ended (see Figure 2).

Two recently published studies[7,8] demonstrate the ability of Alpha-Stim to improve sleep in teachers and first responders. After using Alpha-Stim daily for six weeks, teachers reported an 80.4% decrease in sleep disturbances. First responders, to include both law enforcement and fire fighters, reported a 43.7% decrease in sleep problems. Participants in both studies also demonstrated significant decreases in anxiety, depression and pain that may have exacerbated their sleep difficulties, with no side effects.

Summary

Concomitant with recently reported increases in stress levels, more adults are reporting sleep difficulties. Medications and supplements are frequently used to attempt to improve sleep, but often fall

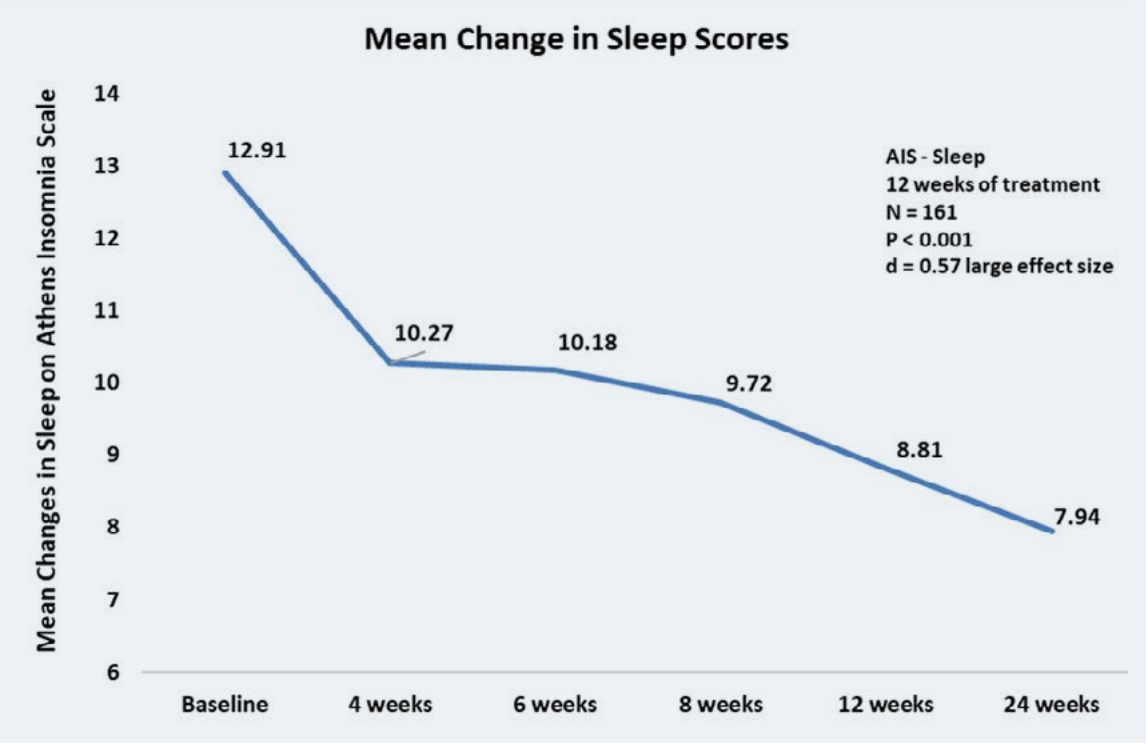

Figure 2 Cumulative improvements in sleep quality in patients diagnosed with Generalized Anxiety Disorder. ©EPI – used with permission

short of being effective and may cause unwanted drowsiness the next day. Alpha-Stim is a safe, easy to use, effective, and cumulative solution to improve both the quality and quantity of sleep, as well as factors such as anxiety, depression, or pain that can be exacerbating sleep difficulties. You can learn more at www.alpha-stim.com.

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